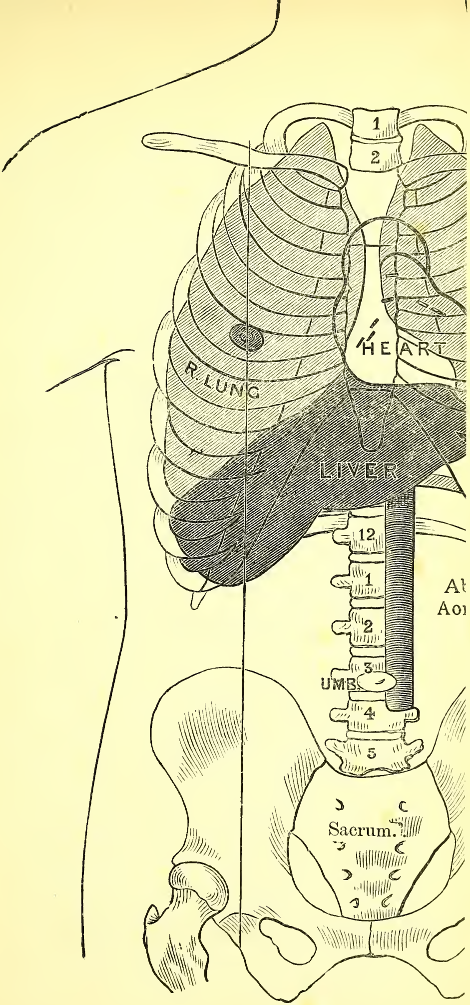
The Dissector's Manual

W. Bruce-Clarke M.A., M.B.
and
Charles Barrett Lockwood F.R.C.S.

MANUALS

FOR

STUDENTS OF MEDICINE.



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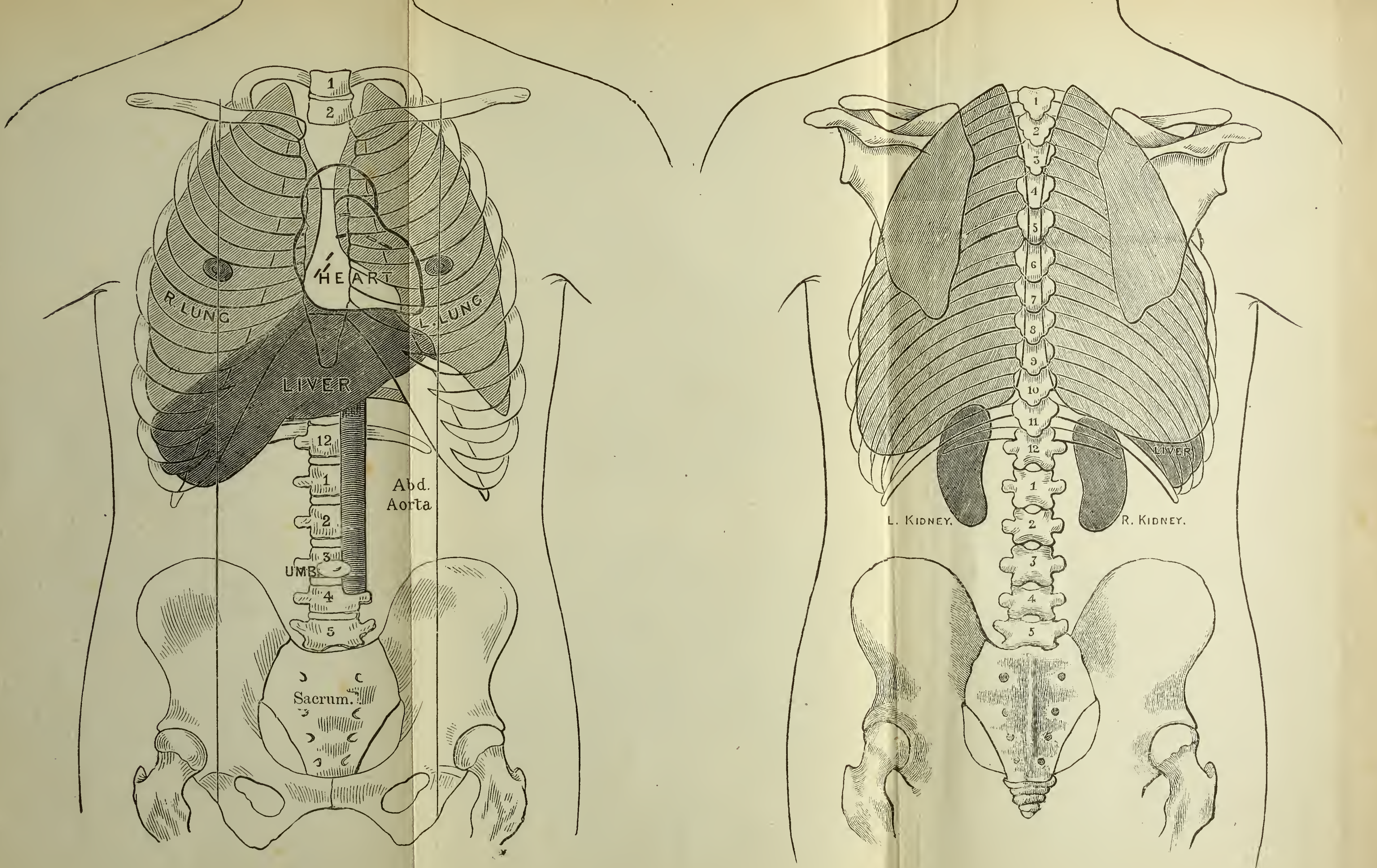

DIAGRAMS SHOWING THE RELATIONS OF THE HEART, LUNGS, LIVER, AND KIDNEYS TO THE VERTEBRAL COLUMN AND RIBS. [*Frontispiece.*

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THE

DISSECTOR'S MANUAL.

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ILLUSTRATED WITH 49 ENGRAVINGS.

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PREFACE.

In this Manual we have endeavoured, as far as possible, to describe the way in which the structures that go to make up the body can be displayed. It is intended that the student should rely on the ordinary text-books of descriptive anatomy for a full account of them, but occasionally it has been found impossible to avoid brief descriptions.

We have described far more fully than is usually done how to find the various structures, and we have endeavoured to state clearly what the student may expect to see, and what he must either take for granted or use special modes of preparation to demonstrate. No apology is needed for doing so. If any branch of medical study is capable of accurate and exact demonstration, it is anatomy, and the student ought clearly to understand that if much is conjectural in physiology or medicine, this is not the case at least with naked-eye anatomy.

The diagrams are, with two exceptions, new, and have been drawn from special preparations, or made at our suggestion, by Mr. Hubert Griffin, a senior student at St. Bartholomew's Hospital. For two diagrams we are indebted to the courtesy of the publishers of Gray's "Descriptive and Surgical Anatomy" and Quain's "Elements of Anatomy."

September, 1883.

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The Dissector's Manual.

CHAPTER I.

HOW TO LEARN ANATOMY.

Anatomy means the science of structure. To learn human anatomy, therefore, is to understand the structure of the human body. In this book, and by the methods which are here described, only naked-eye anatomy can be learnt. Microscopic anatomy, or histology, must be learnt by different methods, and is described in a separate work. The term "anatomy" in the ensuing pages will be employed in reference only to that portion of the subject which is capable of being studied by the unaided eye.

It is *possible* to learn this subject in a variety of ways; the student might learn it by dissection only, without the aid of a single book or bone. Such a method was the only one that could be employed before anything of the science was known, or before any books were written on the subject; but experience has shown that the method which we are about to describe is the best, having due regard to the fact that the student's time is limited, and that a very *accurate* knowledge is indispensable.

The learning of any new subject involves always a certain amount of drudgery, and anatomy is certainly no exception. A number of new, and, at first, meaningless, names have to be committed to memory, and repeated again and again, before any progress is made.

In the first place, the student must provide himself with a good set of bones. He should possess himself of a skull which is cut in two in a vertical antero-posterior direction, and likewise of one which is dis-articulated. He must then select some text-book which treats of human osteology, and, beginning with the larger leg and arm-bones, proceed to learn what his book tells him about them. Their general characters, distinguishing marks, prominences, and muscular attachments must be committed to memory. To obtain any real knowledge of bones, it is essential they should be handled over and over again, and every statement which is made about them in the books must be repeatedly verified.

It will save him an enormous amount of trouble, time, and vexation, if he will always take care to master the bones of any part before he begins to dissect it. In a word, his osteology must always march in advance of his dissection.

Taking for granted that this is the case, he may go into the dissecting-room, where he will be taught to cut the body up, and see how the soft parts are fitted on to the bony framework.

In the ensuing pages, full directions are given as to the method of procedure in all parts of the body; but a few general directions, including a description of some of the commoner terms in use, will not be found out of place.

A body is supposed to have been prepared for dissection by some such method as is described in chapter ii., and the student is supposed to have provided himself with some instruments, which are fully described in the same place.

When thus provided, a portion of the body ("a part"), probably an arm or leg, will be allotted him; and, having provided himself with a set of bones

belonging to that part, he can begin his work with these bones in front of him.

The information which he must seek to obtain is twofold: first, an accurate knowledge of the course and distribution of the various structures; and secondly, a knowledge of exactly how and where they touch each other; in other words, of their relations.

A knowledge of the course and distribution of a vessel or nerve is of great importance; for by this means we are enabled to understand how it is that injury or disease of one part will render the remainder useless, just as the section or rusting of one part of a telegraph wire renders it incapable of transmitting a message. In the same way, a knowledge of relations enables us to understand how it is that affections of one part of the body react on the neighbouring parts.

The method by which this knowledge is obtained is by a study of *surface markings* and by dissection. By the term surface markings is meant the marks which must be made upon the skin to indicate the exact position and size of the underlying structures. Sometimes these surface markings must be taken for granted by the student until he has actually cut into the body and ascertained for himself that they are correct. This is the case with certain of the viscera; but the surface markings with which he will first become familiar are those of the bones, outlines of which can be felt through the skin, and identified by the aid of the bones before him. This is a good opportunity of urging upon the student the importance of studying surface markings on the living body, as by this means he can learn an immense amount of anatomy.

When the surface markings are mastered, it is then time to pass on to the dissection, or cutting up,

of the body. This may, of course, be performed in a variety of ways; but the method and order of procedure which are here adopted are such as will enable the student to see as much as is possible on one body. The skin is removed by making incisions in it, and then stripping it off. The position and size of these incisions is dictated by convenience; thus too much should not be removed at once, or the underlying parts will get too dry to be dissected. Particular care should also be taken not to scrub off the epidermis, or most superficial layer of the skin. As the epidermis serves to keep the skin moist and supple, if it is removed it becomes difficult to take away the integument without injuring the parts beneath.

Underlying the skin all over the body is some tissue, which usually contains fat, and is variously called subcutaneous tissue or superficial fascia. In it run the subcutaneous arteries, veins, nerves, etc. The arteries will be readily identified if injected; if they are not injected, owing to the thickness of their coats they do not collapse, and slight pressure upon them with the forceps shows that they are empty tubes. The veins are thin-coated, and usually contain blood; whilst the nerves are seen as slender white cords, and, when felt, they are evidently not hollow; they convey messages of sensation to the brain and of motion to the muscles. The difference between all these structures will be far better seen in the larger vessels and nerves.

When the subcutaneous tissue is removed, the deep fascia comes into view. It is a dense white, glistening membrane, of varying thickness in different places. From its deep surface various processes are given off, which completely ensheath the deeper parts; so that, if a thin section of a limb were made, the structures could be lifted out of their sheaths, and would leave behind a panel-work of

deep fascia. This will better be appreciated if the student will refer to the diagram of the cervical fascia in section on page 256.

Besides the sheath of deep fascia, each structure has a special casing of its own, of fine fibres called connective tissue, and called, in the case of the muscle, perimysium; in case of the vein, artery, and nerve, their connective tissue sheath. It is in these connective tissue sheaths and in the superficial fascia that the fat is principally contained.

for the most part

Dissection is the cutting away of this connective tissue and deep fascia, and the exposure, as nearly as possible in their relative position, of the muscles, vessels, nerves, bones, and viscera. The process of divesting the muscles, etc., of connective tissue is called cleaning them. To effect this the connective tissue sheath should be firmly seized with the forceps and put upon the stretch; a cut should be made into the sheath, and then the structure must be skinned of its connective tissue, by gently cutting as near it as possible without injuring it. As a rule the student has no difficulty in determining when he has reached the muscle, vein, etc., and when he is only cutting connective tissue, for the latter is loose whilst the muscle, etc., is firm, hard, and of a different colour. A structure is said to be clean when it does not look fluffy if the finger is rubbed over it, and when its surface and fibres are clearly displayed. It is very easy to remove only a part of the connective tissue sheath, but great care must be taken to try and remove it in one layer, for if this mistake is made, the process has only to be repeated.

It may be looked upon as a principle in cleaning, that the student should begin where a structure is large and prominent, and work steadily to the other side or end; but never pick off a little piece here and there. If this is done, the part presents a ragged

appearance, and fails to display important features. Another principle is, never to cut away a structure so long as it is possible to keep it, or its relations to the neighbouring parts will be lost.

Too often when a student has dissected a part he thinks he has done all that is requisite. But now comes the battle, *he must learn it.* He has learnt from his dissecting book how to expose the structures to best advantage, just as he learns from his guide book when he goes abroad what is best worth seeing. But if his knowledge of anatomy is to advance a step farther, he must study it with a work on descriptive anatomy; just as he studies a country whose history he would learn, with a systematic history. Forceps in hand, and descriptive anatomy before him, the part must be diligently gone over and learnt, and looked at, first in one position, then in another, till he knows it. Anatomy must be learnt in the dissecting-room. It is by no means intended that the student should look at no one else's part, but it should only be to supplement the deficiencies of his own, or to compare with others', and test the knowledge he has obtained. The more often he shows and explains his own part to others, the more he will learn about it himself.

By learning his part is meant knowing the distribution, relations, and branches of its nerves, veins, arteries, etc., and the origin, insertion, and relations and actions of its muscles. By the origin of a muscle, is meant that portion of it which remains fixed when it contracts; by its insertion, the end which moves towards the fixed portion. In the case of some muscles, either end may be fixed, in accordance with what particular action they are performing; if this is the case, either end may have the name of origin, but custom has usually given this name to one or other exclusively.

The term relations is often used in an ambiguous sense, and needs therefore a little more explanation. Structures are said to be in relation which touch one another; but oftentimes where a structure is over another, but not touching it, it is said to be in relation with it. In the following pages the word relations will be used only of parts that are in actual contact, and the body will always be supposed to be *standing up and facing* the person who is describing it. We shall therefore speak of the parts which touch any structure, as being "in front," "behind," "on its inner side," and "outer side." The term "middle line" always means the middle line of the body; and in the case of a limb, the terms "inner side" and "outer side" will be spoken of with strict reference to the middle line of the body, and not to that of the limb. In the case of a limb it is advisable, if possible, to avoid using the words inner and outer sides at all, and speak of them rather as the radial and ulnar sides in the arm, or the tibial and fibular sides in the leg.

Any other commonly used terms about which the student may be in doubt, he will find explained in the Glossary which follows.

GLOSSARY.

Anastomosis (Gr. ἀναστομωσις, an opening). Used to denote the joining of blood-vessels with one another; *e.g.*, the circle of Willis, *q.v.*

Anatomy (Gr. ἀνα, apart; τεμνω, I cut). Human Anatomy is the science which teaches the structure of man as learnt by dissection.

Aponeurosis (Gr. ἀπο, from; νευρον, a string, or tendon), the membranous spreading out of a tendon; *e.g.*, aponeurosis of occipito frontalis, *q.v.* Some authors do not properly distinguish between the words "fascia" and "aponeurosis."

Bursa (Lat. a purse), a sac containing fluid. Two varieties: synovial bursæ, which contain synovial fluid, and usually

communicate with joints; mucous bursæ, which contain fluid, and are developed wherever there is constant friction.

Capsule (Lat. *capsula*, a little chest), the membranous bag which encloses an organ. Sometimes wrongly applied to the organs themselves; *e.g.*, suprarenal capsules.

Collateral (Lat. *con*, together; *latus*, a side). Vessels and nerves which run alongside one another are called collateral. When an artery is ligatured, the vessels which run in the same direction enlarge, and form the collateral circulation. To ascertain what collateral channels may exist, it is only necessary to trace the distal vessels, *i.e.*, those which are given off beyond the point of ligature, back towards the heart, and see whether they form any anastomosis.

Clean—cleaning, word used to denote the complete removal of the fat, or connective tissue, from the surface of any structure.

Commissure (Lat. *commissura*, a joining together) usually consist of bands of fibres which unite opposite sides together (transverse commissures). They may run in other directions (longitudinal commissures).

Connective tissue (Lat. *con*, together; *necto*, I knit), in anatomy, the loose fibrous tissue which surrounds and connects everything.

Demonstrate (Lat. *demonstro*, to point out).

Dissect (Lat. *dis*, apart; *seco*, I cut), to cut in such a manner as to display the structure of anything.

Extend, to straighten. The muscles which straighten are called extensors. In the case of the foot, it happens that the straightening is brought about by the flexor muscles, and the bending of the foot upon the front of the leg by the extensors.

Fascia (Lat. a band), connective tissue spread out in a layer. Bundles, bands, sheaths, and arches of fascia are also met with. (*Vide* APONEUROSIS.)

Flex, to bend. The muscles which bend a limb are usually termed flexors. (*Vide* EXTEND.)

Ganglion (Gr. γαγγλιον, a knot), a small mass of nervous matter resembling a knot, found upon nerves. Three varieties of ganglia may be recognised. (*a*) Ganglia found upon nerves; *e.g.*, ganglia on vagus, *q.v.* (*b*) Ganglia by themselves, called solitary or sporadic; *e.g.*, Meckel's ganglion, or the otic. (*c*) Ganglia situated in the central nervous system; *e.g.*, corpus striatum. The ganglia which are situated on nerves and the solitary ganglia

always receive motor, sensory, and sympathetic branches, or roots. They both have branches of communication and branches of distribution. The former include the branches they receive from motor, sensory, and sympathetic nerves; the latter are the branches which the ganglion sends to the structures in its vicinity.

Insertion (Lat. *inserto*, I put in), the end of a muscle which is attached to the part which it moves.

Ligament (Lat. *ligo*, I bind), the fibrous bands which connect bones. Also applied to the layers of fascia which support organs. (*Vide* BLADDER.) Also applied to folds of serous membranes. (*Vide* PERITONEUM and PERICARDIUM.)

Mesentery (Gr. μεσος, middle; εντερον, an intestine), the fold of peritoneum which attaches the small intestines to the spine. The colon, cæcum, sigmoid flexure, and rectum may also possess mesenteries, which are called the meso-colon, meso-cæcum, meso-sigmoidea, and meso-rectum, respectively.

Middle line, unless otherwise stated, *always* means the middle line of the body.

Organ (Gr. ὀργανον, an instrument; derived from ἐργω, I work), a natural living instrument, by which some process or function is carried on.

Origin (Lat. *origo*, I arise), the fixed extremity of a muscle. (*Vide* INSERTION.)

Omentum (Lat. a fat-bag), a great fold of peritoneum which contains fat. Also applied to a smaller fold or ligament of peritoneum which stretches from the liver to the stomach, and to a fold which stretches from the stomach to the spleen.

Plexus (Lat. a network), applied to the arrangement of blood-vessels, nerves, or lymphatics in the form of a network.

Raphé (Gr. ῥαφη, a seam), a term applied to the meeting of parts in the middle line of the body, where they present, in a slight degree, the appearance of having been sewn together.

Relation, used in speaking of the position of parts as regards each other. If close together, parts are said to be in relation. All relations should be spoken of with the body standing up, and facing the observer. Anterior, posterior, internal, and external relations are usually enumerated. The structures between the observer and the part constitute the superficial, or anterior, relations. Internal and external relations should always be spoken of with strict reference to the middle line of the body.

Reflection (Lat. *re*, back; *flecto*, I bend), when used in speaking of membranes, such as the peritoneum, refers to the folds which it makes in passing from the wall of the cavity over an organ and back again to the abdominal wall. (*Vide* diagram, page 119.) Reflection is also applied to the bending of a tendon round a bony point or through a loop; *e.g.*, tensor palati and superior oblique muscle of eye.

Reflect, when applied to the process of dissection, means the turning back of skin, fascia, or muscle.

Septum (Lat. *sepio*, I enclose or hedge in), a partition, usually formed of connective tissue, sometimes of bone or cartilage. (*Vide* Nose.)

Sinus (Lat. a bay or indentation), applied, *a*, to cavities in the cranial bones which contain air; *b*, to canals in the membranes of the skull (dura mater) containing venous blood; *c*, to dilations of veins themselves (*vide* Jugular sinus, Coronary sinus); *c*, to dilations of the walls of arteries (sinus of Valsalva); *d*, to spaces bounded by the free edge of muscles (sinus of Morgagni).

Surface markings, marks which would have to be made upon the skin to indicate the size, shape, and position of the underlying parts. Sometimes the subjacent parts are so prominent that their outline (or surface marking) is visible.

Theca (Gr. θηκη, a sheath), the name given to the fibrous sheath which encloses tendons (especially of the fingers), also to the dura mater of the spinal cord.

Ventricle (Lat. *ventriculus*, a little belly), applied to the cavities of the heart, brain, and larynx.

Villi (Lat. *villus*, wool or hair), applied to minute projections of the mucous membrane of the small intestine, also to projections from the choroid plexuses (*vide* Brain) or from the placenta.

CHAPTER II.

USE OF INSTRUMENTS, AND MODE OF PREPARATION OF THE BODY FOR DISSECTION.

The instruments which are required to enable the different structures which compose the body to be displayed are few in number. Two or three scalpels, a pair of scissors, a pair of forceps, two or three sets

of hooks upon chains, a blow-pipe, a saw and a pair of bone-nippers, are all that are required. To these a hone or good razor-strop should certainly be added. It is quite impossible to make a good dissection unless the student has a very good and very sharp scalpel. The dissecting cases which are usually sold contain six knives. Three are quite enough. The diagram shows the sort of knife which will be found most suitable for dissecting purposes (Fig. 1). The knives should be chosen of different sizes, the smallest having a blade of about two inches from heel to point. These knives should never be permitted to become blunt. When the student is dissecting he should always have a smooth hone or a razor-strop by him, and sharpen the knife as soon as it loses its edge. Knives vary greatly in the way in which they keep their edge. A well-tempered knife holds its edge for a long time, and is not difficult to sharpen. A little practice is required to enable the student to sharpen his own knives; it is necessary to attend strictly to the following rules:

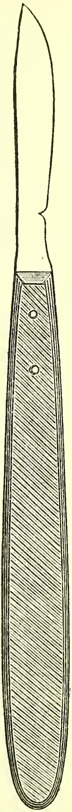


Fig. 1.
Scalpel.

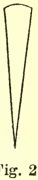


Fig. 2.

Fig. 3.

Fig. 4.

(1) Always to draw the knife along the strop from heel to point.

(2) Always to turn the knife upon the back of the blade.

(3) Always to hold the knife absolutely flat upon the strop.

It is usual to compare the edge of a knife to a fine saw. By observing the first rule, the serrations will slant towards the point. As in cutting the blade is to be drawn from point to heel, it will cut more smoothly if set in this way. The meaning of the second rule is obvious, but students so frequently break it that it seems necessary to emphasise it. The third rule is continually being broken. The blade of a knife, if seen in section, should form a perfect wedge (Fig. 2.) To preserve this wedge-shape it is evidently imperative that the knife be held flat upon the strop. It is quite true that *at first* it can be made very sharp by holding it at an angle to the strop (Fig. 3); but after awhile the consequences of this become apparent, for the perfect wedge-shape is completely destroyed, and the knife requires to be ground (Fig. 4). When a knife has been properly sharpened, it should never be laid down upon a table, but at once placed in its box. Knives laid upon the table are in great danger of being knocked off and their points destroyed.

To use a knife for dissecting purposes, it should be held like a pen. The point should be used to find the smaller structures, and not to cut with. Cutting should only be done with the convexity of the blade. The point of a knife is generally blunt, and is always the hardest part to sharpen.

Forceps should be chosen of a fair size (Fig. 5). The blades are to be held between the index and middle fingers and the thumb of the left hand; they should therefore be at least half an inch wide. The forceps should have just sufficient spring to cause them to open themselves when relieved from pressure. If

found to have too strong a spring, it may be easily remedied by grasping both ends of the forceps strongly and bending them backwards and forwards; or the upper end may be held in the gas-flame or fire until it first begins to arrive at a dull-red heat. It should then be allowed to cool slowly. The points should be fine, and not too much serrated, and should meet accurately. It seems needless to point out the use of forceps, but it should be clearly understood that they are *not* to be used to seize muscles, arteries, veins and nerves, *but only the connective tissue* which surrounds them.

The scissors should be either straight or curved. They should not be too loose or too stiff in the joints, and the blades should accurately meet. The hooks should be small and sharp, and should be fastened together by means of a chain or whip-cord.

Bone-forceps are not usually included in dissecting cases, but they are so frequently in use that the student is strongly recommended to provide himself with a small strong pair. The larger bone-forceps and saws are provided in most dissecting rooms.

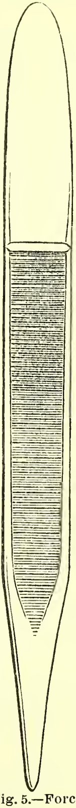


Fig. 5.—Forceps.

Fig. 6. Blow Pipe.

Instruments less frequently in use will be mentioned when they require to be brought into requisition.

How to prepare a body for dissection.—As soon as possible the body should be placed in a tank and thoroughly washed with warm water. All the hair should afterwards be shaved off the head, face, axilla, and pubes, etc. To enable it to be kept the time requisite for dissection it must be injected with a proper embalming or preservative fluid. A fluid made after the following receipt has been shown by a considerable experience to answer admirably.

White arsenic	60 ozs.
Salts of tartar	32 ozs.
Carbolic acid (common black) . .	2 pints
Glycerine	$\frac{1}{2}$ gallon
Water	$\frac{1}{2}$ gallon

Let the above ingredients gently simmer over a fire till the whole is in solution. A little less water can be used if it is desired to keep the body for some months, but much less must not be employed, or the fluid will not remain soluble when cold. This fluid will keep any length of time.

It is usual to inject about three pints of the above fluid into a body (a large body will take considerably more); and if the subject is to be kept for some time, more fluid will be easily taken up if a day or two be allowed to elapse before a second attempt is made.

Instead of a syringe, a can or old teapot raised up about ten feet, with an indiarubber tube attached to it, makes a good injector.

When a day or two has been allowed to elapse to allow the preservative fluid to be absorbed by the tissues, the colouring matter should be injected. For this purpose a syringe must be employed, as it sets rapidly.

For the coloured injection, take, for an average-sized body,

Red lead	$\frac{1}{2}$ lb.
White lead	$\frac{1}{2}$ lb.
Boiled linseed oil	12 ozs.

Mix thoroughly with half a pound of best dryers, and strain through fine canvas.

Then add turpentine varnish a pint, which must be previously warmed by standing the vessel which contains it in hot water; the mixture will set hard in about an hour or two. If it is desired to make a firmer injection, more dryers must be used.

The ingredients of the preservative injection can be obtained at any chemist's; the coloured injection, at an oil and colour shop.

The body is usually injected through the aorta in the following manner: An incision is made from the top to the lower end of the sternum, and the bone sawed through in the middle line. The two halves of the sternum are next forcibly separated by means of a wedge, and the pericardium freely opened with knife or scissors. With a very large and strong iron aneurism needle, a thick string is passed round that part of the aorta which is within the pericardium. A cut having been made in the aorta, a large canula is introduced and fastened by means of the string, and the injection introduced through it. If it is desired not to injure the thorax, the body may be injected through the common femoral artery. The artery merely requires to be exposed and opened sufficiently to admit an up and down (*i.e.* double) canula.

In England only a limited time is allowed, by the anatomy Acts, for the dissection of the body. It is therefore necessary to arrange the order in which the different parts should be examined. The following

table indicates roughly a convenient distribution of the time :—

1st to 4th day.—Body on back.
4th and 5th days.—Body in lithotomy position for dissection of perineum.
6th day.—Body replaced upon its back.
10th, 11th, and 12th days.—Body turned for dissection of the muscles of the back, gluteal and popliteal regions.
13th day.—Body replaced on back for the dissection of the parts beneath the clavicle, and, after this has been done, the removal of the arm.
21st day.—Removal of left leg for side view of pelvis.
23rd day.—Removal of right leg.

CHAPTER III.

DISSECTION OF THE ARM.

The dissection of the arm is usually considered to include the pectoralis major and superficial muscles of the back, and also the structures which cover them.

The dissection is most conveniently conducted in the following order :

1. The pectoralis major and structures which cover it.
2. The axilla.
3. The front of the arm.
4. The bend of elbow and front of fore-arm.
5. Palm of hand.
6. The superficial muscles of the back, trapezius, latissimus dorsi, levator anguli scapulæ, and rhomboids.
7. The removal of the arm from trunk.
8. Dissection of deltoid and scapular region.
9. Back of arm.
10. Back of fore-arm.
11. Back of hand.
12. Joints and ligaments.

Before commencing to dissect any portion of the body, the student should make it a rule to examine carefully with his finger all the bony prominences, and

to learn all the surface markings. If he is unable to find any of the bony prominences which are mentioned, a properly articulated skeleton should be referred to; and if still in fault, he should call in the assistance of his teacher or of a senior student. The surface markings of this region are:

The clavicle.
Acromion process and
Spine of scapula.
Coracoid process.
Angle of sternum (angle of Ludwig).
Ribs and intercostal spaces.
The nipple: its relation to the chest wall and intercostal spaces.
Outline of pectoralis major.
Interval between the pectoralis major and deltoid.
Interval between sternal and clavicular origins of pectoralis major.

At this period of the dissection the body is lying upon its back, with the arms extended at right angles upon boards; it should be raised to a convenient height from the table by means of blocks. The outspread arms are fastened to the boards, with the palms upwards, by means of string. No difficulty should be experienced in tracing, with the tips of the fingers, the outline of the clavicle, acromion process, and spine of scapula. The angle of the sternum is about two inches below its upper border (in the adult), and at the junction of the first and second bones of the sternum. The coracoid process is situated in the interval between the pectoralis major and deltoid. Upon the dead subject this interval is not easy to discern, especially when the body is fat; but upon the living person is easily found by putting the muscles into action. The student may take an opportunity to see this upon his own person. The same remarks apply to the interval which usually exists between the sternal and clavicular attachments of the pectoralis major. A reference to the attachment of the muscles to the clavicle will aid in finding these intervals. To feel the coracoid, the shoulder should be firmly

grasped with the hand, so that the thumb is in front, and firmly pressed into the hollow beneath the junction of the outer with the middle third of the clavicle. The process lies just internal to the head of the humerus, so that, to avoid confusion, the arm should be rotated. The head of the humerus, of course, turns; the coracoid does not. (To do this, the arm must be detached from the board, and considerable force used.) In the male the nipple lies over the fifth intercostal space. (*Vide* Frontispiece.) It is of importance, as it indicates the position of the heart's apex, etc. The lower border of the pectoralis major is well defined, and forms the front boundary of the armpit (axilla).

Before making any skin incisions, the student must remember that he is going to remove the skin in as thin a layer as possible, leaving all the subcutaneous fat upon the surface of the muscles. This subcutaneous fat contains the cutaneous nerves, cutaneous blood-vessels, and the mammary gland, so that, unless care is taken in removing the skin, these structures are liable to be destroyed. If this be the first attempt at dissection, the student may easily fail in his endeavours to find either nerves, blood-vessels, or glands; but as a great many nerves and vessels require to be dissected during the next stage, this is a good opportunity of gaining a little experience. In this country subjects for dissection are so difficult to obtain, and the time which the examining boards permit to be devoted to anatomy is so short, that in nearly all schools an attempt is made to display all the more important structures upon one part. Under more favourable circumstances, the first part should be devoted only to the study of the muscles and largest vessels and nerves. The skin may therefore be removed from the surface by the following skin incisions.

1. From sternal end of clavicle outwards to the middle of its concavity.

2. Along the whole length of the centre of the sternum.
3. At right angles to the lower extremity of the last incision as far as a line drawn down the middle of the axilla (mid-axillary line).

The skin having been seized with the forceps at the upper and inner part, a start may be made, and as soon as possible the skin should be seized with the fingers and kept upon the stretch. It should then be removed in one thin layer from the subcutaneous tissue towards the axilla, the nipple being left behind. The cuts should be made with the blade of the scalpel, and not with the point. The cutaneous nerves come from the superficial cervical plexus, intercostals, and lateral cutaneous branches of the intercostals. The first descend from the neck over the upper part of the sternum and clavicle; the anterior branches of the intercostals come out of the intercostal spaces close to the sternum, and the lateral branches of the intercostals wind forwards round the axillary border of the pectoralis major. (*Vide* Fig. 15.) In looking for cutaneous nerves an endeavour should be made to find some guide to them. Small arteries, for instance, emerge with the anterior branches of the intercostals, and being injected, form ready guides to the nerves. The other nerves run by themselves. In looking for them, or, indeed, for any nerves (or small arteries), two rules should be observed:— 1. To begin to look for them where they are thickest and strongest. 2. To make all exploratory incisions in the direction in which they run. In removing the subcutaneous tissue over the clavicle, a thin layer of muscular fibres will come into view. They belong to a muscle called the platysma-myoides, which becomes much better developed in the neck. It is the best example of a cutaneous muscle which exists in the human body. Beneath its fibres,

and close to the clavicle, the descending clavicular branches of the cervical nerves should be found. They lie quite close to the bone, and frequently groove it; they sometimes pierce it. Having been found in this region, they should be traced downwards. The nerves themselves should not be taken hold of by the forceps, but the subcutaneous tissue alongside should be pulled away from the nerve, and divided along its course. The lateral branches of the intercostal nerves which wind round the pectoralis major, are more difficult to find, owing to their small size and the large quantity of fat which usually exists in this region. The small anterior branches of the intercostal nerve may be found coming out of the front portion of the intercostal spaces along with small arteries, which may serve as guides to them. If the body is lean they present no great difficulty, but the aid of a skilled dissector should be obtained if the subject is fat.

Dissection of mammary gland.—In a favourable subject the mammary gland should now be dissected. A female about 30 years old would be the likeliest to afford a good one. The gland is small in the male, and can hardly be said to exist in many of the very old bodies which find their way to the dissecting-room. If the subject is not a favourable one, the pectoralis major may be cleaned at once; but supposing the mamma is well-developed, the gland will be found beneath the nipple lying upon a mass of fat. The gland substance may be distinguished from the fat by its finer, and closer, and more opaque appearance. The student should endeavour to make out its circumference and lobes. Under favourable circumstances its ducts, about twenty in number, with their dilatations (ampullæ), may be found by making incisions into the gland. The incisions should be in the course of the ducts, and

therefore radiate from the nipple. The arteries which supply the gland principally descend into it from above. One (the long thoracic) should be sought for entering the gland from beneath the axillary edge of pectoralis major, others piercing the intercostal spaces in front, coming from the internal mammary artery; others enter the under-surface of the gland, and come from the intercostals.

The surface of the pectoralis major may now be cleaned from origin to insertion, the mammary gland being taken completely away. The cutaneous vessels and nerves should be preserved as far as possible. It will be found best never to cut anything away until absolutely obliged. If the different structures are preserved and frequently looked at, they become impressed upon the memory in a short time, and almost unconsciously. In order to clean the pectoralis major, the fascia which covers it should be seized at its axillary border, and a cut made through it well into the muscular fibres. The cut edge should be drawn firmly upwards, and the delicate fibrous septa which the fascia sends between the muscle bundles should be followed a little way into the muscle substance and divided. All cuts should be made with the blade of the knife, and in the direction of the fibres, and the fascia removed, as far as possible, in one piece. As all muscles require to be dissected in a similar way, these directions will not be repeated. As the insertion of the muscle is approached, caution must be exercised, and the fibres traced only as far as the margin of the deltoid. The upper edge of the muscle is separated from the deltoid by an interval containing a vein and artery (cephalic vein and thoracica-humeraria artery). The vein and artery may be seen most easily presently, but as the vein in its empty condition is small and collapsed, it is in danger of division unless looked for.

Dissection of the costo-coracoid membrane.—The clavicular attachment of the pectoralis major should next be divided close to the clavicle, and turned downwards and outwards, to expose

The costo-coracoid membrane, and piercing it, the Cephalic vein.	Thoracic axis, and Anterior thoracic nerves.

The costo-coracoid membrane or ligament is a layer of fascia which stretches from the cartilage of the first rib internally to the coracoid process externally. Above, it is attached to each side of the subclavian groove upon the clavicle, splitting to pass in front of and behind the subclavius muscle, which is inserted into the groove; below, it sends a thin prolongation between the pectoralis major and minor, and a thicker one beneath the minor into the axilla. These prolongations join again below the muscle, so that the costo-coracoid membrane may be said to form its sheath. The cephalic vein is most easily traced towards the membrane from the anterior margin of the deltoid. The thoracica - humeraria artery may serve as a guide to it. This artery comes either directly or indirectly from the axillary artery which lies beneath the costo-coracoid membrane. The branches of the axillary artery are given off very irregularly. It is usual to divide the course of the axillary artery into three parts: (*a*) above the pectoralis minor, between it and the clavicle; (*b*) beneath the pectoralis minor; and (*c*) below the lower edge of the pectoralis minor. In the first part of its course one branch,* the thoracic axis, is given off. This artery immediately divides into an ascending, descending, and transverse branch. These are the arteries which pierce the costo-coracoid membrane.

* Afterwards it will be seen that in the second part of its course the axillary gives off two branches, in the third three.

The ascending branch (acromial-thoracic) runs over the coracoid process towards the acromion. The transverse branch (thoracica-humeraria) descends in the interval between the deltoid and pectoralis major with the cephalic vein. The descending branch (short thoracic, or superior thoracic) descends between the pectoralis major and minor to supply them. All these arteries should be found and traced as far as the membrane. A nerve (the external anterior thoracic) should be looked for running close to the superior thoracic artery, and entering the posterior surface of the pectoralis major. The costo-coracoid membrane should be gradually dissected away, and the nerve followed over the axillary vein and artery to join the outer cord of the brachial plexus. As the membrane is gradually cut away, a nerve (the internal anterior thoracic) which emerges *between* the axillary artery and vein, and descends to enter the inner surface of the pectoralis minor, should be looked for and preserved. It will afterwards be seen to come from the inner cord of the brachial plexus. After supplying the pectoralis minor it usually ends in the major. When the costo-coracoid membrane is removed, the things seen are :

The commencement of the vessels and nerves already mentioned.
The axillary artery.
The axillary vein.
Subclavius muscle.
Brachial plexus of nerves.

Dissection of first part of axillary artery.—The axillary artery is a continuation of the subclavian artery of the neck. It descends beneath the clavicle and pectoralis major and minor into the armpit, and runs down the arm to the bend of the elbow under the name of brachial. The student should learn, concerning the axillary artery, the places where it begins and where it ends ; its course and its branches, and its relations. The beginning and ending

are most frequently overlooked, but it is evident that unless these points are known it would be impossible to mark out the course of the artery. The axillary vein is of considerable size, and even when empty greatly overlaps the artery. It should be cleaned and pulled downwards to expose the artery. As its walls are thin, care must be taken not to open it ; the vein usually contains a quantity of blood, which escapes and obscures all the other structures. When the artery and its branches have been found, the cords of the brachial plexus should be sought for above the former. The tendinous origin of the subclavian muscle, and its insertion into the clavicle, should, lastly, be made out. If it does not interfere with the dissector of the head and neck, this is a favourable opportunity to examine the sterno-clavicular articulation. The capsular ligament of this joint should be cleaned, and afterwards opened to display its synovial membrane, and its interarticular fibro-cartilage.

Dissection of the axilla.—The arm still being extended at right angles to the trunk, the boundaries and surface markings of this important space should be made out ; they are :

Line of the axillary artery.
Coracoid process.
Head of humerus.
Pectoralis major, forming anterior boundary.
Latissimus dorsi, forming posterior boundary.
Chest wall and serrations of the
Serratus magnus, forming inner boundary.

To expose the axillary contents the following skin incisions may be made : 1. Downwards and outwards towards the arm, from the concavity of the clavicle to the place where the surface markings of the axillary artery terminate. 2. A circular incision round the arm just below the folds of the axilla. The skin flap must

be dissected downwards in a thin layer, and, after the axillary fascia has been removed, the cutaneous nerves must be searched for amongst the mass of fat which fills the space. Before attempting to dissect the cutaneous nerves an idea of their course and direction is essential. They come from the lateral cutaneous branches of the intercostal nerves. Each of the intercostal nerves, except the first, which is very small, gives off in the middle of its course (*i.e.*, almost in the axillary line) a lateral cutaneous branch. As soon as these nerves emerge from the intercostal spaces, they divide into a branch which runs forward and a branch which runs backwards. Some of the anterior branches have been seen already running over the border of the pectoralis major. The posterior branches run backwards over the latissimus dorsi. The upper two posterior branches, however, instead of running backwards over the latissimus dorsi, run down the inner side of the arm, and are called intercosto-humeral nerves. These nerves, coming out of the intercostal spaces, run outwards across the axilla, embedded in its fat. The anterior branches of the lateral cutaneous nerves have to be found, and, as the fat of the axilla is removed, should be traced to the origins. The posterior branches may afterwards be traced as far as the edge of the latissimus dorsi. The intercosto-humeral nerves lie rather high in the axilla, at the level of the second and third intercostal spaces. As they run transversely, they should be looked for by incisions made in that direction. When traced to the arm, they are usually found communicating with the small internal cutaneous branches of the inner cord of the brachial plexus. The only cutaneous artery found in the axilla is a long unnamed branch of the axillary, which runs down the centre of the space. Before completely tracing the nerves the student should endeavour to obtain some

idea of the axillary fascia. This fascia is close beneath the skin of the axilla, and simply covers in its contents, by being attached to the fascia of the arm and the sheaths of all the muscles which bound the axilla. For instance, it stretches across from latissimus dorsi to the pectoralis major, and above it is attached to the sheaths of the pectoralis major and minor, below to the side of the chest. It will be remembered that the costo-coracoid membrane formed the sheath of the pectoralis minor, so that, as the axillary fascia is fastened to the sheath below, they mây be said to be continuous with one another. It will be found very difficult to make out the axillary fascia as a distinct membrane, but as far as possible it should be attempted. Beneath the fascia the following structures require dissection :—

Boundaries of axilla.
Intercosto-humeral nerves.
Nerve of Bell.
Lymphatic glands.
Axillary vein and its branches.
Axillary artery and its branches
Alar thoracic, and
Long thoracic.
Anterior circumflex,
Posterior circumflex,
Subscapular.
Brachial plexus, and its subscapular branches, three in number.

The method to be adopted in dissecting a space such as the axilla, is, first to learn and define its boundaries, afterwards to make out roughly its principal contents. When the positions of each have been noted they are to be treated more in detail. The boundaries of the axilla have already been mentioned. The principal contents are situated at the apex, and along the anterior ând posterior boundaries. The dissector should therefore begin to work amongst the fat in the centre of the axilla, and proceed towards the circumference. The intercosto-humeral nerves are most likely to be divided, but should be dissected as previously mentioned. The axillary lymphatic glands

are very numerous, and are chiefly in its apex and beneath its anterior border, where they receive the lymphatics from the mamma. They should be removed one by one. To remove them they should be seized and pulled upon with the forceps; as they are dragged out, their connective tissue and fat should be divided quite close to their capsule, and the gland isolated, until it remains attached by its blood-vessels. When it has been seen whence its blood-supply is derived, the gland should be removed. The axillary lymphatic glands derive their blood-supply from an artery called the alar thoracic. The long thoracic artery should be traced downwards beneath the anterior boundary, towards the mammary gland, and upwards until it is lost beneath the pectoralis minor. The subscapular artery is to be found running down the posterior boundary of the space. In the centre, close to the chest-wall, lies the nerve of Bell. In order to trace these structures up to their origin, the pectoralis major should be divided about two inches from its insertion, and the ends turned inwards and outwards. The whole of the pectoralis minor may now be cleaned, and the apex of the axilla made out. The different cords of the brachial plexus can be partially dissected where they are in relation with the axillary artery; but the highest part of the plexus lies in the neck and beneath the clavicle. It should be left until the posterior triangle of the neck has been dissected sufficiently to enable the bone to be divided, and the nerve tissues followed upwards. The student should consult his text-book for a full account of the brachial plexus. The axillary artery will have been brought into view by the time the plexus is finished; its remaining branches, anterior and posterior circumflex and subscapular, should be made out one by one. As the subscapular is cleaned, it will be seen shortly after its

origin to give off a branch (dorsalis scapulæ) which, when the muscles have been cleaned, will be seen to pass through a triangular opening bounded by them. The posterior circumflex artery will be seen to run backwards a little above it, disappearing with its accompanying nerve through a quadrilateral opening. The boundaries of both these openings should be examined and learnt. Coming from the posterior end of the brachial plexus, and quite at the back of the axilla, are the three subscapular nerves; they supply three muscles: latissimus dorsi, the teres major, and subscapularis. The latissimus dorsi is farthest from the posterior cord, and is therefore supplied by the longest nerve, the long subscapular nerve; the teres major, nearer to the cord, is supplied by the middle subscapular nerve; and the subscapularis, upon which the posterior cord lies, is supplied by the short subscapular nerve. The nerves run in a vertical direction down the axilla, and are to be sought for by vertical cuts. The long subscapular nerve is the easiest to find, and should be looked for as it enters the muscle, and traced upwards. The other nerves lie parallel to it, but very deep in the axilla. When these nerves have been found, the three muscles which they supply should be cleaned as far as is possible. The tendinous intersections of the subscapularis are usually visible. The veins of the axilla correspond to the arteries, and should be dissected with them. When filled with blood they are of considerable size.

Front of the arm.—The following surface markings of the arm and bend of the elbow should be made out:

External condyle of humerus.	Cephalic vein.
Internal condyle of humerus.	Basilic vein.
Olecranon process of ulna.	Line of brachial artery.
Head of radius.	Line of musculo-spiral, median, and ulnar nerves.
Outline of biceps.	

No difficulty should be experienced in finding the bony points. The head of the radius is the only one which presents any difficulty, and may be felt for by grasping the arm, so that the thumb is beneath and behind the external condyle of the humerus. If the fore-arm be rotated (*i.e.*, pronated and supinated) the head of the bone will be felt moving. This is most easily felt on the living subject. The meaning of the expressions pronation and supination should be understood. When the hand is laid with its palm upon the table, it is said to be pronated ; when laid with its back upon the table, it is said to be supinated. The act of turning the hand over on to its palm is called pronation ; the act of turning it on to its back, supination. The cephalic vein begins at the bend of the elbow, and its course can usually be followed external to the biceps, where it has already been seen, between the pectoralis major and deltoid. The basilic vein lies internal to the biceps, and can usually be followed but a little way upwards from the bend of the elbow. The course of the brachial artery is indicated by a line drawn from just beneath the anterior fold of the axilla to a point midway between the two condyles of the humerus. The course of the median nerve is indicated by the same line continued almost to the centre of the palm of the hand, where the nerve terminates. To indicate the course of the musculo-spiral nerve, a line should be drawn from the centre of the axilla spirally round the back of the arm, until it arrives in front of the external condyle. The line which indicates the course of the ulnar nerve begins at the middle of the outer boundary of the axilla, to behind the internal condyle of the humerus ; from thence it should continue down the inner side of the fore-arm, straight to the radial side of the pisiform bone. The skin may now be reflected from the front of the arm

by the following incisions: (*a*) a circular incision an inch above the condyles of the humerus; (*b*) a vertical incision along the course of the brachial artery, from the circular incision made below the fold of the axilla to the one which has just been made above the condyles of the humerus. When the skin has been reflected in a thin layer well to the inner and outer side of the arm, the cutaneous nerves and veins should be sought for. The basilic vein should first be looked for in the lower part of the arm lying internal to the biceps. It should be followed upwards as far as the middle of the arm, where it pierces the deep fascia. It will afterwards be seen to join the accompanying veins of the brachial artery to form the axillary vein. The cephalic vein lies external to the biceps. The cutaneous nerves of the arm consist of two great groups, internal and external. The accompanying list shows the order in which they lie, from above downwards, upon the inner and outer sides of the arm and fore-arm.

Internal.	*External.*
Intercosto-humeral.	Short external cutaneous.
Internal cutaneous of musculo-spiral.	Long external cutaneous.
Lesser internal cutaneous.	Musculo-cutaneous, or external cutaneous.
Internal cutaneous.	

The first two internal branches are small, and difficult to find, unless traced from their origins. The intercosto-humeral has already been seen crossing the axilla. Its dissection may now be completed. The lesser internal cutaneous nerve lies near it, but becomes cutaneous lower down. An internal cutaneous branch of the musculo-spiral lies parallel to them, but nearer the back of the arm. The short external cutaneous branch of the musculo-spiral lies quite to the outer side of the arm close to the cephalic vein, and its long external cutaneous appears a little lower

down. The next two nerves, the internal cutaneous and the external cutaneous (from musculo-cutaneous), exactly correspond. They both come out of the deep fascia about the middle of the arm, the internal cutaneous at the place where the basilic vein pierces it, the external cutaneous a little lower down.

Soon after piercing the fascia, each nerve divides into an anterior branch running down the fore-arm to the wrist, and a posterior which winds round to the back of the arm, just below the condyles, and descends to the wrist. It will be seen that three internal cutaneous and three external cutaneous branches have been enumerated. Later on, their dissection may be completed. The deep fascia of the arm should be removed, and the brachial artery and veins cleaned. The student should apply the same rule to the brachial artery as he applied to the axillary, viz., to learn its beginning and end, course, relations, and branches. This rule holds good for every artery and large vein or nerve. The origin of the superior and inferior profunda and anastomotica magna arteries should be made out, but they should only be traced as far as the inner side of the arm. Each cord of the brachial plexus should be taken in its turn, and its branches traced, as far as can be conveniently done, without moving the arm. As far as the smaller arteries of the arm are concerned, it may be remarked that most of them run with the larger nerves. As soon as the arteries, veins, and nerves have been seen, the muscles may be taken in their turn and cleaned. The greater part of the deltoid may be dissected at this stage; the biceps, coraco-brachialis, brachialis anticus, and inner head of triceps, should be cleaned as far as the lowest skin incision.

Directions of bend of elbow and front of fore-arm.—The following surface markings require to be made out :

Styloid processes of radius and ulna.
Veins at bend of elbow.
Outlines of pronator radii teres, and supinator longus.
Tendon of biceps.
Tendons at front of wrist.

From within outwards :
Flexor carpi ulnaris.
Flexor sublimis digitorum.
Palmaris longus.
Flexor carpi radialis.

Course of radial artery and nerve.
Course of ulnar artery and nerve.
Course of median nerve.
Exact position of wrist-joint.

If the radius and ulna be followed downwards, each will be found to end in a pointed process (styloid processes). They indicate the position of the wrist-joint. If the hand be completely flexed upon the fore-arm, a transverse wrinkle appears at their level which marks the line of the joint, which is much higher than it is usually expected to be. The veins at the bend of the elbow are often a little irregular. They can easily be studied upon the student's own arm. If pressure be made in the arm over the course of the cephalic or basilic veins they become prominent. The depression in front of the bend of the elbow, in which so many important structures lie, is bounded below by two converging muscles, the supinator longus and pronator radii teres ; their position and outline should be noted. The tendons at the wrist are important, as they are the guides to the radial and ulnar arteries and their accompanying nerves. They can easily be examined by the student upon his own wrist. A line drawn from the middle of the bend of the elbow *straight* down the arm to the radial side of the tendon of flexor carpi radialis indicates the course of the radial

artery. A line drawn from the middle of the bend of the elbow to the pisiform bone marks the course of the ulnar artery. This line should curve well towards the ulnar side of the arm until it meets the line of the ulnar nerve, at the junction of the upper with the middle-third of the fore-arm. The line of the nerve and artery afterwards coincide.

The skin should be removed from the front of the bend of the elbow and of the fore-arm by the following incisions: (*a*) a circular incision at the level of the styloid processes of the radius and ulna; (*b*) a longitudinal incision in the line of the median nerve. The skin having been reflected well towards the radial and ulnar sides of the fore-arm, the internal and external cutaneous nerves should be followed down from the arm, and the cutaneous veins made out. The nerves at the upper part of the arm, as a rule, lie beneath the veins. The tendon of the biceps should be cleaned, and its semilunar expansion to the fascia of the fore-arm preserved. The median basilic vein usually lies upon this expansion, and is separated by it from the brachial artery. The deep fascia may be removed, and the bend of the elbow dissected. The boundaries of this space should first be made out, and afterwards its contents. The muscles attached to the supinator ridge, and to the front of the inner condyle, are first to be cleaned. The median nerve and brachial artery should next be traced, the artery until its division into radial and ulnar.

The supinator longus should next be drawn towards the radial side of the arm with hooks, and the musculo-spiral nerve searched for, lying between it and the brachialis anticus, and piercing the external intermuscular septum. The external intermuscular septum is a strong layer of fascia prolonged from the deep fascia of the arm to the whole length of the external condylar ridge. It serves for the attachment

of muscles. The internal intermuscular septum has a similar origin and use. The origins of the external cutaneous branches of the musculo-spiral nerve and its branches to the supinator longus and extensor carpi radialis longior, should be made out, coming off where the nerve lies in contact with the muscles. The arterial anastomosis around the elbow-joint may next be dissected. There is always an abundant arterial anastomosis around joints, but nowhere so free as round the elbow. If the student flexes his own elbow very strongly, and, whilst doing so, keeps his finger upon his radial artery, he will find that when the joint is completely flexed the pulse stops. The anastomosis around the joint is so free, that if the flexion were continued the lower part of the arm would not cease to have a sufficient supply of blood. The anastomosis is carried on by arteries, which ascend and descend before and behind each condyle. There must therefore be four ascending and four descending arteries. Nearly the whole of this anastomosis will be seen to be linked together by an artery (anastomotica magna), which rises from the brachial and runs round just above the condyles. Before endeavouring to make out any of the anastomosis, it will be found easier to complete the dissection of the front of the fore-arm in the following order:

Muscles attached in inner condyle.	Radial artery and nerve.
Muscles attached to front of outer condyle.	Ulnar artery and nerve.
	Median nerve and its artery,
	Comes nervi mediani.

When these have been accomplished, the superficial flexors should be replaced, and the dissection continued in the following order:

Anastomosis around joint.	Anterior interosseous artery and nerve.
Deep flexors.	Supinator brevis.
Common interosseous artery.	Pronator quadratus.

Each muscle should be taken in its turn, and its origins and insertions (as far as possible at present) and its nerve supply should be made out. It should be clearly seen that the whole of the extensor muscles are supplied by the musculo-spiral nerve; in other words, that every muscle on the back or extensor surface of the arm is supplied by the musculo-spiral nerve. From the main nerve-trunk only three (triceps, supinator longus, and extensor carpi radialis longior) are supplied. The posterior interosseous nerve supplies all the rest. *All* the flexor muscles, those upon the front of the fore-arm and palm of the hand, are supplied by the median and ulnar nerves, which must be carefully dissected and their branches made out. In the fore-arm the ulnar nerve only supplies the flexor carpi ulnaris, and partially the flexor profundus digitorum, the two muscles between which it lies; all the rest are supplied by the median. Many of the flexor muscles arise by more than one head. These various origins are to be carefully made out and learnt. Before dissecting the ulnar and radial arteries their branches should be learnt, and afterwards found. Unless this is done in the case of *every artery*, its branches are exceedingly likely to be severed from the main trunk. The branches which arise from them high up enter into the anastomosis around the elbow-joint, which may now be made out.

Anastomosis round elbow-joint.—It has been remarked before that the arteries principally accompany the great nerves. The student should look for an artery running with the musculo-spiral nerve in front of the external intermuscular septum. This is the anterior branch of the superior profunda, and it should be followed down with the nerve until it anastomoses in front of the external condyle with the recurrent branch of the radial.

When the back of the arm is dissected, the student will see that, before the superior profunda passes through the external intermuscular septum it gives off a large branch, which runs down the back of the intermuscular septum, to anastomose behind the external condyle with the recurrent branch of the posterior interosseous artery. It may therefore be said that the superior profunda divides into two terminal branches, which descend to anastomose in front of and behind the outer condyle. The inferior profunda artery, which runs with the ulnar nerve, divides in a similar manner. The anterior branch runs down in front of the inner condyle, to anastomose with a recurrent branch (anterior ulnar recurrent) of the ulnar artery. The posterior runs with the ulnar nerve behind the internal condyle, to anastomose with another recurrent branch of the ulnar artery (posterior ulnar recurrent). The anterior ulnar recurrent runs superficially, and close to the ulnar side of the median nerve. The posterior ulnar recurrent runs beneath the superficial flexors and over the flexor profundus. The remaining artery, and that which forms the greatest anastomosis, is the anastomotica magna. It arises from the inner side of the branchial, a little above the condyles, winds round the inner side of the arm, piercing the internal intermuscular septum, runs transversely between the triceps and the back of the humerus, to end behind the outer condyle. It anastomoses with all the arteries about the elbow, with the exception of those in front of the outer condyle. It cannot at present be dissected behind; but, when it is, it will be seen to receive an additional anastomosing branch from the superior profunda.

The common interosseous artery and the deep flexors (flexor longus pollicis and profundus digitorum) may now be cleaned, and the anterior

interosseous nerve and artery looked for between them, lying upon the interosseous membrane. The nerve may be followed into the pronator quadratus; the artery through a hole in the interosseous membrane.

When the long extensors have been dissected below the external condyle a small muscle (supinator brevis) is to be seen, almost encircling the upper end of the radius. The musculo-spiral nerve ends upon it in the radial and posterior interosseous nerves; the latter pierce the muscle. The relations, origin and insertion, and mode of action of the supinator brevis should be accurately learnt. The student may be assisted by Fig. 7. The posterior part of the supinator brevis may be dissected when the arm is turned over. The pronator quadratus may now be dissected, and the palm of the hand begun.

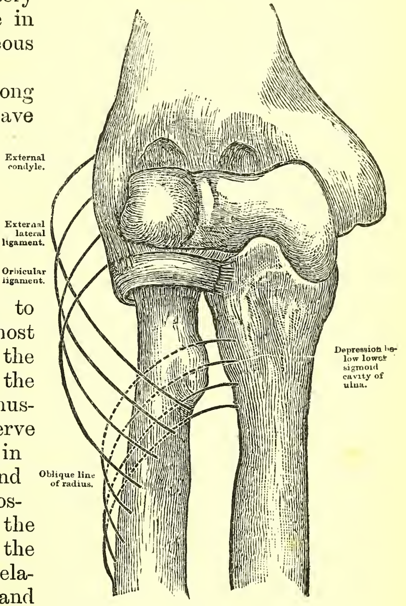


Fig. 7.—Supinator Brevis Muscle (Arm).

Dissection of the palm of the hand.—The following surface markings require to be made out:

Tuberosity of scaphoid.	Superficial and deep palmar arches.
Ridge of trapezium.	Line of metacarpo-phalangeal joint.
Pisiform bone.	
Unciform process.	
Thenar and hypothenar eminences.	

The bony prominences can easily be recognised by reference to an articulated hand. The thenar eminence is the prominence formed by the muscles of the thumb; the hypothenar eminence is that formed by the muscles of the little finger. The line of the superficial palmar arch is indicated by a line drawn across the palm at the level of the flexor surface of the outstretched thumb; the deep palmar arch is about an inch nearer the wrist. The metacarpo-phalangeal joint is marked by a transverse line situated about midway between the bases of the fingers and the line of the superficial palmar arch.

The skin of the palm may be reflected by the following incisions: (*a*) a vertical one, from the centre of the circular incision above the wrist to the fork between the ring and index fingers; (*b*) a transverse incision across the base of the fingers; (*c*) along the thenar eminence, from the scaphoid tubercle to the tip of the thumb; (*d*) along the palmar aspects of any of the fingers. The cutaneous nerves which lie in the palmar fat are small branches of the median and ulnar nerves which cross the annular ligament. They are small, and difficult to find, but as they run vertically, any incisions made to find them should take this direction. A small muscle (palmaris brevis) is also to be looked for in the fat over the hypothenar eminence. As it runs transversely, incisions made to find it should run in that

direction. When these structures have been found, the dissection may be conducted in the following order :

Structures crossing the annular ligament, viz. :
- Palmaris longus,
- Ulnar artery,
- Ulnar nerve,
- Palmar cutaneous nerves.

Palmar fascia.
Muscles of ball of thumb.
Muscles of little finger.
Reflection of palmar fascia.
Superficial palmar arch, and superficialis volæ.
Nerves, median and ulnar.
Lumbricales.
Tendons and structures which pass beneath the annular ligament.
Deep branch of the ulnar nerve.
Deep palmar arch.
Deep muscles of palm.
A finger.

All the structures which cross the annular ligament will have been seen, and only require to be followed down into the palm. The palmaris longus ends in the palmar fascia, which should be cleaned, and its divisions followed between the fingers. The palmar fascia is very difficult to clean, but if the point of the knife be dipped well in amongst the fibres which compose it, less difficulty will be experienced in removing the fat and fibrous tissue from its surface. The muscles of the ball of the thumb, abductor, superficial head of flexor brevis and opponens pollicis, should be cleaned from origin to insertion. In doing this, care must be taken not to remove the recurrent branch which they receive from the median. It lies close to the radial edge of the palmar fascia, and close to where the muscles arise from the annular ligament. To dissect the muscles of the little finger (abductor and flexor brevis minimi digiti) the palmaris brevis should be removed. The deep branch of the ulnar nerve, and artery, are to be carefully preserved, as they descend between the two muscles. The palmar fascia should be divided close to the annular ligament, and turned towards the fingers. The superficial palmar arch, median nerve,

superficial branches of ulnar nerve, and the lumbricales, are to be dissected in order, and the nervous and arterial branches made out. The lumbricales are attached to the deep flexor tendons, and must be traced round to their attachments at the back of the fingers. The small branches from the median and ulnar nerves can usually be made out by a skilful dissector. The superficial palmar arch lies immediately below the fascia. It will be seen to be formed by the superficial branch of the ulnar joining with the superficialis volæ, a branch of the radial artery which usually crosses or pierces the abductor pollicis. The skin should be reflected from at least one finger, and the nerves and arteries traced along it. In order to see the deep palmar arch and deep branch of the ulnar nerve, it is necessary to divide the annular ligament; but before doing so, its attachments to the scaphoid and trapezium on the radial side, and to the pisiform and unciform on the ulnar side, should be observed. The flexor carpi radialis pierces it; when it has been divided, the median nerve, superficial and deep flexors, and flexor longus pollicis, can be seen to pass beneath it; later on some recurrent branches of the deep palmar arch will come into view, also passing beneath. The median nerve and all the flexors should be divided, and, along with the superficial palmar arch, turned towards the fingers. The deep branch of the ulnar nerve, and artery, may now be traced into the palm. They will be seen to be given off as soon as their trunks have crossed the annular ligament, then to pass between the abductor and flexor brevis minimi digiti, wind the unciform process, and go beneath the muscles attached to it (flexor brevis and apponens minimi digiti) to break up in the palm. After making out the apponens minimi digiti, the deep palmar arch and its branches may be dissected. The course of the deep branch of the ulnar artery has been followed. The radial artery

enters the palm, coming from the back of the hand, between the deep head of the flexor brevis and adductor pollicis, to unite with the deep branch of the ulnar to form the deep arch.

The deep head of the flexor brevis pollicis and abductor pollicis should be traced from origin to insertion, and the thecal sheath of one of the fingers dissected. The arrangement of the fibres of the theca should be examined. The part opposite the middle of phalanges, where the theca is strongest, is called vaginalia. Opposite the phalangeal joints the fibres form a cross, constituting the ligamenta cruciata. The thin part of the vaginalis, that near the joints, is sometimes called annularis. The theca should afterwards be split open, in order to examine the arrangement and attachment of the flexor tendons. The synovial sheath which surrounds them is, in the case of the thumb, derived from a very large synovial sac, which surrounds the flexor tendons in the arm. The sac extends from the junction of the lower with the middle third of the arm into the palm, and is called the great carpal bursa. After passing beneath the annular ligament, it sends, as was said before, prolongations along the thumb and little finger. The synovial sheaths which surround the tendons of the index, ring, and middle fingers, come from a common sac, which is situated opposite the base of the fingers.

Dissection of the superficial muscles of the back.—The muscles of the back which act upon the upper extremity are usually dissected by the student in dissecting the arm. The time at which the body is turned over to permit their dissection, varies in different dissecting-rooms. (*Vide* table, page 16.) The body should be turned over upon its abdomen, and blocks placed under the chest and pelvis. The head should hang down somewhat, in order to put the

muscles as much as possible on the stretch. The surface markings to be made out are the

External occipital protuberance.	Iliac crests.
Vertebra prominens.	Erector spinæ.
Ligamentum nuchæ.	Trapezius.
Spines of dorsal and lumbar vertebræ.	Latissimus dorsi.
	Spine and angles of scapula.

The dissection of the head and neck and abdomen will have, in addition, the surface markings of the

Lungs.	Kidneys; and
Liver.	Colon, right and left.

(For these latter surface-markings refer to page 285 and to Frontispiece.) Although not strictly belonging to the arm, the student may see what these surface markings ought to be.

By remembering and examining the attachments of the muscles to the bones, the student should not experience any difficulty in ascertaining their proper relation to the skin. In the living subject they should be put in action, to show their outlines properly.

The skin incisions which are requisite to expose the muscles of the back, are: (*a*) From external occipital protuberance down to the sacrum; (*b*) from the acromion process as far as twelfth dorsal spine; (*c*) round the iliac crests; (*d*) (if not already made) an incision along the anterior border of the trapezius. The skin flaps should be reflected, and in the subcutaneous tissue, which is usually abundant, cutaneous nerves should be traced, coming from the posterior branches of the dorsal and cervical nerves. The acromial branches of the superficial cervical plexus, and the posterior branches from the lateral cutaneous branches of the intercostal nerves, should also be sought for. These nerves have already been seen winding backwards round the border of the latissimus

dorsi. They may now be more completely traced; the cutaneous branches of the posterior divisions of the cervical and dorsal nerves pierce the trapezius and latissimus dorsi a little external to the spines of the vertebræ. If they cannot be found in the subcutaneous tissue, their points of emergence will be found when the muscles are cleaned. The muscles of the back which belong to the arm are the

Trapezius.
Latissimus dorsi.
Rhomboids.
Levator anguli scapulæ (lower part).

Each muscle is to be cleaned from origin to insertion, and its nerve supply made out (if not already done). The trapezius may be begun near its occipital attachment, and its connective tissue removed in the direction of its fibres. The great occipital nerve piercing it close to the skull should be found, and traced upwards towards the scalp. The other nerves will be found emerging in a linear series below it. The attachments of the latissimus dorsi may next be made out; and a small triangular interval, bounded by the anterior edge of the latissimus, the posterior edge of the external oblique muscle of the abdomen, and the crest of the ilium, made out. In this small triangular space the fibres of the internal oblique muscle of the abdomen can be seen. The trapezius should be divided about two inches from its insertion to the clavicle and spine of the scapula, dissected up and turned towards the opposite side. In doing this, its nerve supply from the spinal accessory nerve, and the transversalis colli artery, are to be found and cleaned. If the spinal accessory nerve has not been found by the dissector of the neck, it should be looked for entering the upper and internal surface of the muscle. The latissimus dorsi should afterwards be cut through below the inferior angle of the scapula. When this has been

done, the rhomboids and levator anguli scapulæ should be cleaned. The nerve to the rhomboids from the brachial plexus and the posterior scapular artery run close together beneath these muscles, which they supply. When they have been found, the rhomboids and levator anguli scapulæ may be divided near the scapula, and their course and distribution more clearly made out. Instead of dividing these muscles, it will be found an excellent plan to saw through the posterior edge of the scapula vertically. The cut should be about a quarter or half an inch from the posterior edge, and is intended to leave the strip of bone with the levator anguli scapulæ, rhomboids, and the serratus magnus attached to it. Unless this is done it is not easy to get a proper idea of the relations of these muscles to the chest wall. The head and neck will have been dissected enough by this time to permit the arm to be removed from the body, and its dissection completed.

Removal of arm from trunk.—The clavicle should be divided at its centre, and afterwards the pectoralis minor and subclavius divided. The ends of the clavicle may now be separated, and the brachial plexus and subclavian artery and vein more completely dissected and learnt. When this has been done, the plexus and vessels should be cut through and tied to the clavicle; the omo-hyoid muscle, suprascapular artery and nerve, posterior scapular artery and nerve to rhomboids (if necessary), should be divided. The arm can now be removed from the trunk, leaving the muscles attached to the posterior border of the scapula upon the chest wall. The arm may now be laid upon the table, and dissected in the following order:

Muscles of the shoulder, and
Back of arm.
Back of fore-arm.
Back of hand.
Ligaments and joints.

Before doing this, the student should recapitulate all the parts cut through in removing the arm from the body. The skin having been reflected from the surface of the deltoid, a cutaneous nerve may be looked for winding round its posterior edge, to supply the skin which covers the muscle. It comes from the circumflex nerve, and is a good example of the *very* general rule which says that the nerves which supply muscles supply the skin which covers them. The acromial branches of the superficial cervical plexus will have been traced to the surface of the deltoid by the dissector of the head and neck. When these cutaneous nerves have been found, the surface of the deltoid must be cleaned from origin to insertion, and the muscle reflected from its origin. The process of reflection should begin at the posterior end of the spine of the scapula, and as the muscle is turned forwards the posterior circumflex artery, vein, and nerve will be seen entering its under surface. When they have been found, the fat and connective tissue which surround them must be removed, and great care be taken to trace a branch of the nerve into the teres minor, and a branch of the artery into the long head of the triceps. These branches are given off from the posterior circumflex nerve and artery just after they have emerged from the quadrilateral space previously mentioned. The nerve as it enters the muscle often has a gangliform swelling upon it; and the artery is very important, because when it has entered the long head of the triceps it anastomoses with a branch of the superior profunda which enters it as the artery crosses the muscle. This is the only anastomotic channel by which collateral circulation can be carried on when the axillary artery is tied in the third part of its course, that is, beyond all its branches. The supraspinatus, teres major and minor, and infraspinatus, should each be cleaned in their

turn. The acromion process should be sawn through at its junction with the spine of the scapula, and turned out of the way to permit the insertion of the supraspinatus to be seen. When this has been cleaned, this muscle and the infraspinatus should be removed from their attachments to the scapula, in order that the suprascapular artery and nerve and the dorsalis scapulæ artery may be seen anastomosing. The suprascapular artery usually passes over the suprascapular ligament which bridges over the suprascapular notch. The suprascapular nerve usually passes under the ligament, and therefore through the notch. They both wind round the edge of the spine of the scapula, the artery anastomosing with the dorsalis scapulæ, which emerges from beneath the teres minor. This artery was previously found in front, and appeared to pass through the triangular muscular interval. Evidently it does not pass completely through.

Dissection of the back of the arm.—The skin may now be stripped from the back of the arm as far as the elbow. A few small cutaneous branches may be traced from the musculo-spiral nerve into the subcutaneous tissue of this region. The triceps should first be completely and carefully cleaned from origin to insertion, and then the musculo-spiral nerve and superior profunda artery dissected. The branches of the musculo-spiral have been nearly all made out; they may be classified as follows: Branches given off before the nerve enters the musculo-spiral groove, viz., internal cutaneous nerve and branches, to inner and middle heads of triceps. In the musculo-spiral groove is given off a large branch to the triceps and anconeus; externally, and outside the groove, are given off two cutaneous branches, and branches to the supinator longus, extensor carpi radialis longior, and sometimes the brachialis anticus. The nerve to the inner head of the triceps (ulnar collateral nerve)

should be found running for some distance alongside the ulnar nerve. The substance of the triceps must be divided over the course of the musculo-spiral groove, in order to see the course of the nerve and artery through it. The nerve to the anconeus is given off in the middle of the groove, and runs down to the outer condyle in the middle of the substance of the triceps. The muscle should be divided vertically along the course of the nerve, which can be traced behind the external condyle into the anconeus. Near the condyle, branches may be traced from it into the capsule of the elbow-joint. A branch of the profunda artery accompanies it down in the substance of the muscle, and has been already mentioned as entering the arch joined by the anastomotica magna round the back of the humerus. To see this arch the anastomotica magna should be traced from the front of the arm, where it has been already found, by cutting transversely through the internal intermuscular septum and triceps. The remaining branches of the nerve were dissected with the front of the arm.

Dissection of the back of the fore-arm.— The surface markings of the back of the fore-arm are the

Spine (posterior ridge) of the ulna.
Head of the ulna.
Olecranon process.
Head of the radius.
Lower end of radius (already seen).

The way to find the head of the radius has been described. (*Vide* page 29.) The remaining surface markings are very simple and require no description. If a circular incision was made completely round the fore-arm at the level of the styloid processes of the ulna and radius, nothing remains but to remove the skin. The posterior branches of the internal and external cutaneous nerves may be traced round into the subcutaneous tissue from the front of the arm,

and the posterior radial and ulnar veins followed from the back of the wrist. This having been done, the deep fascia should be removed. As many of the muscles are partially attached to it, it is almost impossible to avoid leaving their surfaces a little rough. The dissection should be conducted in the following order:

Superficial extensor muscles.	Deep extensors.
Posterior interosseous nerve and artery.	Anconeus.
	Supinator brevis.

The superficial extensors should be cleaned one by one from the external condyle as far as the wrist. They should be separated, to show the posterior interosseous nerve emerging from the substance of the supinator brevis. This nerve should be traced downwards between the superficial and deep extensors, until it passes underneath the extensor secundi internodii pollicis to run down on the back of the interosseous membrane. When the back of the hand has been dissected the nerve may be followed to the back of the carpus, where it ends in a gangliform enlargement (usually situated beneath the tendon of the extensor indicis). The posterior interosseous artery pierces the interosseous membrane at the lower border of the supinator brevis. It immediately gives off a large branch (recurrent interosseous), which runs up between the supinator brevis and anconeus, to anastomose with the posterior branch of the profunda and the anastomotica magna. The continuation of the artery runs with the posterior interosseous nerve as far as the upper margin of the extensor secundi internodii pollicis; at this point it ends in the anterior interosseous artery, which runs through the interosseous membrane from the front of the arm, and accompanies the posterior interosseous nerve down the membrane until it ends in the posterior carpal arch. The

extensor muscles should be separated from the outer condyle, in order that the supinator brevis may be properly displayed; the radial artery and musculo-spiral nerve may also be cut away at this stage if they are found to impede the view. The student may now consider what skin incision would require to be made, and what structures removed, in order to expose the supinator brevis. Lastly, the extensors of the thumb and index finger may be cleaned as far as the posterior annular ligament.

Dissection of the back of the hand.—The surface markings of this region comprise the following extensor tendons, enumerated in their order from radial to ulnar side:

Extensor ossis, and
Primi internodii pollicis.
Extensor carpi radialis longior and brevior.
Extensor secundi internodii pollicis.
Extensor indicis.
Extensor communis digitorum.
Extensor minimi digiti.
Extensor carpi ulnaris.
Posterior radial and ulnar veins.
Radial artery.
Posterior branches of ulnar and radial nerves.

The extensor tendons may be distinguished from each other by observing their relations to the bones and the direction in which they run. The veins collect the blood from the fingers, and, like the tendons, can best be seen upon the student's own hand. The radial artery lies at the root of the thumb, in the triangular depression between the extensor secundi internodii pollicis and the extensor primi internodii. The cutaneous nerves from the ulnar and radial are given off from their parent trunks a little above the wrist. They wind backwards, passing beneath the tendons of the supinator longus and extensor carpi ulnaris to be distributed to the fingers; the ulnar the same as in the palm, the radial the same as the median in the palm. These branches are so often overlooked, that

it seems desirable to acquire a knowledge of them before making the skin incisions. The skin may be removed by the following incisions: (*a*) across the heads of the metacarpal bones, and over the thumb as far as the radial side of the first joint; (*b*) a vertical incision from the circular incision at wrist, along the dorsum of the middle finger; (*c*) an incision along the dorsum of the thumb. The skin having been reflected, the dissection should be conducted in the following order:

Cutaneous nerves and veins.	Radial artery.
Annular ligament.	Dorsum of fingers and thumb.
Tendons.	Posterior carpal arch.

The cutaneous nerve from the ulnar should be looked for coming out from under the tendon of the flexor carpi ulnaris; that from the radial emerging from beneath the tendon of the supinator longus. When they have been found their distribution should be carefully made out. The veins at the back of the hand in the collapsed state are very small. They are so easily seen on the back of the student's own hand, that he need not waste much time in their dissection. The attachments of the posterior annular ligament should next be examined, and the fascia removed from the surface of the tendons. It will be found that tendons can most easily be cleaned by scraping them with the point of the knife. Upon one of the fingers the way in which the interossii and lumbricales are attached to the extensor tendons should be examined.

The radial is the principal artery at the back of the hand. The course of this artery from the front of the radius to the place where it passes between the heads of the first dorsal interosseous muscle should be made out. The artery passes beneath the extensor ossis metacarpi, primi internodii, and secundi internodii pollicis, lying upon the external lateral ligament

of the wrist and back of the carpus. Its close proximity to the joint between the thumb and the carpus (trapezium) should be noticed. The branches which the radial gives off should be carefully made out, and afterwards the extensor tendons removed to expose the posterior carpal arch, the branches of which should be made out. It may be observed that the little finger only gets a slip from the common extensor low down, but that the tendon of the extensor minimi is double.

Dissection of ligaments.—The upper extremity may now be denuded of its muscles in order that its joints may be studied. Should the part by this time have become very dry, it should be soaked in water for a day or two before the ligaments are dissected. In order to display these structures to the best advantage, the point of the knife should be dipped well between the fibres. Whilst doing this they are to be put well upon the stretch. When the ligaments have been cleaned in this way, the periosteum should be removed from the bone in their vicinity, in order to make their exact limits distinct.

The joints which are to be dissected with the upper extremity include the

Sterno-clavicular.	Elbow.
Acromio-clavicular ligaments of outer end of clavicle.	Wrist and carpus.
Shoulder.	Joints of the fingers.

An early opportunity should have been seized to examine the sterno-clavicular articulation. Its capsular ligament having been cleaned, it should be opened, and its fibro-cartilage examined. The rhomboid ligament (costo-clavicular) may be examined at this time.

No particular directions are required for the dissection of the coraco and acromio-clavicular ligaments.

Shoulder-joint.—Concerning the shoulder-joint, it is necessary to ascertain its

Movements.	Nerve and blood supply.
Ligaments.	Relations.
The openings into it.	

The range of movement of the shoulder-joint may best be studied upon the living subject. The relations of the joint have already been acquired, but the student should see upon a skeleton how the different muscles are attached around the joint, and examine their relations upon a dissected part. When the capsule of the shoulder has been cleaned, the apertures in it should be made out.

The most important opening is situated beneath the tendon of the subscapularis. The muscle should be separated from the scapula, and lifted up to expose the aperture (foramen ovale) in the capsule. At this opening a prolongation of the synovial membrane finds exit from the joint, and the tendon of the subscapularis enters it to get to its insertion. The tendon of the biceps also enters the joint, and, to see it, the capsule should be divided by a vertical incision over its course. By widely opening the capsule, the tendon of the biceps may be seen to divide at the top of the glenoid cavity, to blend at each side with the glenoid ligament. Besides the openings for the subscapularis and biceps, there is usually another for a prolongation of synovial membrane beneath the infraspinatus.

Elbow-joint.—The same directions apply to the elbow as to the shoulder, as far as the dissection of the ligaments is concerned. The bones which enter into its formation and its ligaments are to be studied. It may be taken as an excellent specimen of a hinge-joint. If the rotatory movement of the radius be ignored, the joint only permits of hinge movements, viz., flexion and extension. Such joints as this are

very simple, as far as their ligaments are concerned. The arrangement in all of them is that there are ligaments at each side, called external and internal, and in front and behind, called anterior and posterior. The joints of the wrist, fingers, knee, and ankle all conform to the above rules. It is necessary to learn the attachments of these ligaments, and see under what conditions they are tight or slack. Afterwards, any special ligaments are to be learnt; the orbicular in the case of the elbow, the fibro-cartilage in the wrist.

Wrist.—The relations and external ligaments of the wrist should be made out. Afterwards its capsule should be opened, and the triangular fibro-cartilage examined. The ligaments of the carpus (dorsal, palmar, and interosseous) may be afterwards examined, and those on the dorsum divided to expose the synovial sacs of the wrist and carpus. The metacarpo-phalangeal and phalangeal joints should be observed to be devoid of posterior, but to have especially thick anterior, ligaments.

CHAPTER IV.

DISSECTION OF THE LEG.

For purposes of dissection, the leg includes the os innominatum, and the structures by which the leg is attached to it.

It may conveniently be divided into the following regions, which should be dissected in regular order from above downwards if possible. The body is usually turned over on to the face, before the whole of the front of the leg is finished, and in this case

the back of the leg should be begun and continued until the body is turned on to its back again, when dissection of the front will be resumed.

Upper third of thigh in front.— Before making any incisions, the principal surface-markings as far as the knee should be mastered. The student may examine the whole of these upon his own body.

The crest of the ilium.
The anterior superior spine of ilium.
Great trochanter.
The spine and crest of the pubes.
Poupart's ligament.
The patella and condyles of femur.
The adductor tubercle situated just above the inner condyle.
The line of the femoral artery.
The tubercle of tibia and head of fibula.

The student who knows his bones will hardly find any difficulty in identifying the above-named surface-markings.

Forming a well-marked prominence at the upper and outer extremity of the leg, even in the fattest bodies, is the anterior superior spine of the ilium, and the bony ridge which can be traced backwards and outwards from this to the iliac crest. Just below the spine is another prominence of bone, the great trochanter of the femur, which will be readily felt, as it alters its position when the leg is moved.

Just above the penis or vagina, as the case may be, is a bony mass, formed by the pubic bones. The place in the middle line where the two bones join is called the symphysis. About three-quarters of an inch outside the symphysis another prominence (the spine of the pubes) can be felt if the body is not very fat. Running from this point to the anterior superior spine of the ilium, a band can be felt (Poupart's ligament). The patella will readily be recognised, either on the student's own body or on the part before

him, lying loose on the front of the knee. Farther back, two more prominences (the condyles of the femur) will be felt; and if the knee-joint is healthy, well-marked depressions will be seen at each side of the patella. They are of great importance, as their absence proclaims the presence of some abnormal condition (usually fluid in the joint). Next, at the upper part of the internal condyle of the femur, a well-marked prominence, the adductor tubercle is found, which is of considerable importance, as a line drawn from it up to a point midway between the anterior superior spine of the ilium and the symphysis pubis, marks the course of the femoral artery.

The prominences of bone round the head of the tibia and fibula, being almost all of them subcutaneous, will readily be examined with the finger.

The various surface markings must be carefully compared with the actual points on the bones themselves, and when this has been done dissection can be started.

List of Structures to be Dissected in upper third of Thigh.

Cutaneous vessels:
- Saphenous vein.
- Superficial epigastric, Superficial and deep external pudic, Superficial circumflex iliac } arteries and veins.

Cutaneous nerves:
- External.
- Middle.
- Internal.
- Crural branch of genito-crural.
- Inguinal branch of ilio-inguinal.

Femoral glands.

Femoral hernia.

Boundaries and floor of Scarpa's triangle and its contents, including
- Femoral and profunda arteries and veins.
- Anterior crural nerve and branches.
- Anterior branch of obturator nerve (sometimes).
- Lymphatic glands.

Make an incision in the line of the femoral artery, carrying it down to the junction of the upper third with the middle third of the thigh. At the upper end of this incision make another, following the line of Poupart's ligament, and at the lower end carry an incision half way round the limb horizontally. Care must be taken not to cut deeper than the skin, and to leave all the fat and subcutaneous tissue still attached to the limb, as it contains the subcutaneous vessels and nerves, which are the first structures to be looked for.

The fat connective tissues which underlie the skin vary greatly in amount in different people, and obviously where the fat is greatly in excess, the subcutaneous vessels and nerves are more difficult to find.

If the body is a thin one, on the inner side of the thigh, running down towards the inner side of the knee, will be seen a large vein, the internal saphenous. If the body is a fat one, the student must lay hold of the fat with his forceps, and, carefully removing it by vertical cuts, he will come upon the commencement of the vein, about an inch and a half outside the spine of the pubes. Some very small veins, which can be traced inwards till they empty into the large one, may serve as guides.

If the leg is the first part which the student has undertaken, and any difficulty is experienced, he should seek the aid of a Demonstrator.

When the internal saphenous vein is once found, it should be followed until it disappears under the deep fascia (fascia lata). Close by where it disappears, some oval bodies (inguinal lymphatic glands) about the size of cherry-stones will be seen, about an inch below Poupart's ligament. The upper edge of the hole (saphenous opening) through which it disappears will probably be brought into view first. If the fascia be seized close to its edge, and dissected

outwards in thin layers, the nature and shape of the aperture will be better seen, and a thin layer of fascia will be visible uniting its edges. The fascia can be seen, in a thin body, to be perforated by numerous small holes, which give exit to numerous small arteries, veins, and nerves, and it is therefore called the cribriform fascia. In a fat body these holes are so filled up with fat that the fascia can only be made out by an experienced dissector.

When once the cribriform fascia is made out, the edges of the ring should be farther traced, in order to make out their attachment. The upper edge (falciform process) must be traced inwards to the spine of the pubes, whilst externally it curls downwards to pass under the vein, and becomes continuous with that portion of the fascia lata called the pubic, whilst the part of the fascia lata which lies over the vein is called its iliac portion. The Fig. at page 121 will explain the formation of this opening if any further difficulty exists.

Entering the saphenous vein, close to the saphenous opening, are two or three subcutaneous branches, which, if they contain blood, can be readily traced to their sources. Descending from the abdomen, and usually dissected more by the dissector of the abdomen than of the leg, is the superficial epigastric vein. Passing upwards and outwards towards the anterior superior spine of the ilium is the superficial circumflex iliac; and in a contrary direction towards the pubes, the superficial external pudic. All these veins accompany small arteries, which, if injected, serve as guides to them, but if not injected will not be very easy to find.

The first nerves to be sought for are the crural branch of the genito-crural, and the inguinal branch of the ilio-inguinal. They are very small, and are often not found, especially by inexperienced dissectors.

The genito-crural nerve comes forward external to the femoral artery and vein, and must be sought for by carefully scraping, in a vertical direction, with the scalpel in that situation; whilst the inguinal branch of the ilio-inguinal emerges at the external abdominal ring, just over the pubic crest, and passes down on the part of the leg, over that part of the upper edge of the saphenous opening which is attached to the spine of the pubes. The larger portion of this nerve goes to the scrotum, and is dissected with the abdomen. The external middle and internal cutaneous nerves all pierce the fascia lata, several inches below Poupart's ligament. No very definite rules can be given for finding them, except that it is advisable to begin dissecting at the outer side of the leg above, and clean the fascia lata downwards and inwards, watching very carefully on its under surface for the nerves, and only making very small cuts, otherwise the nerve will be cut away before the dissector knows where he is. The middle cutaneous nerve usually emerges about in a line with the femoral artery ; the external, close to the outer side of the limb ; and the internal, which is small, just external to the saphenous vein.

The position of the saphenous opening should be carefully borne in mind, as it is the passage by which a femoral hernia escapes.

The coverings of a femoral hernia from without inwards will be as follows :

Skin.
Superficial fascia.
Cribriform fascia.
Crural sheath (femoral sheath), } fascia propria
Subperitoneal fat (septum crurale *), } of Astley Cooper.
Peritoneum.

* Some regard this as an extra layer of fascia superficial to the subperitoneal fat.

The first three coverings (skin, superficial fascia, and cribriform fascia) have already been dissected; the three latter must be verified when the dissection has proceeded further.

When the hernia has emerged from the saphenous opening, it turns upwards towards the abdomen; but even when this has occurred, it can readily be distinguished from an inguinal hernia, as *its neck* is situated below and to the outer side of the pubic spine, whilst an inguinal hernia is above, and to the inner side.

The fascia lata must now be removed by similar incisions to those which were employed in the case of the skin, care being taken not to cut away the external middle and internal cutaneous nerves.

Scarpa's triangle will be exposed, and will be seen to be bounded on the outside by the sartorius, coming from the anterior superior spine of the ilium to meet the inner edge of the adductor longus, which passes down from the pubes to form the inner boundary, the base of the triangle being formed by Poupart's ligament.

When the fascia lata is removed, the femoral artery will probably at once be visible; if not, it can readily be felt as a rounded cord if the body is injected. The student should proceed to clean it at once, by laying hold of the areolar tissue, which surrounds it, with his forceps, and carefully dissecting it off, taking great care not to cut away any of the small branches. Those arteries which were seen on the superficial surface of the fascia lata must be traced to the femoral.

On the inner side of the artery the femoral vein must be cleaned; there will not be the slightest difficulty in finding it, if the saphenous vein is traced upwards; but considerable care must be exercised in cleaning its walls, as they are very thin, and may contain fluid

blood, which will run about and mess the dissection if the vein is cut. If this does happen, the vein must be tied across above and below where the cut was made, to prevent the blood from flowing over the dissection.

When the vein and artery have been traced down to the apex of Scarpa's triangle, and cleaned, they can be pulled with hooks slightly to the outer side. This will expose on their under surface the origin of a large vein and artery, the profunda, or deep femoral vein and artery. Their origins should be cleaned, so as just to indicate where they lie; but no further dissection should be attempted in this direction at present, or important structures may be wounded.

The student will bear in mind that three parts of the femoral artery and vein have now been exposed:

(1) The common femoral (or that part of the artery which runs from Poupart's ligament to where the profunda is given off, and is usually from two to three inches in length).

(2) The superficial femoral (which comprises the remainder of the artery, between the profunda and the popliteal, and the course of which has yet to be made out).

(3) The profunda femoris (which has yet to be traced).

Outside the femoral artery lies the anterior crural nerve. It consists, just below Poupart's ligament, of numerous small fibrils, bound together by a tough connective tissue, which is extremely difficult to strip off neatly so as to bring the nerve into clear view.

It should be cleaned in the same fashion as the artery and vein, and its various branches, which it begins to give off almost at once, made out. It supplies all the muscle which can at present be seen, except the adductor longus, and gives off the middle and internal *cutaneous* nerves.

If the nerve be traced from Poupart's ligament downwards, its branches will be readily made out, with a little care. The student should notice that the middle cutaneous pierces the sartorius.

If by any chance he has not found the middle and internal cutaneous nerves, he should endeavour to rectify his error by tracing all the branches of the anterior crural with redoubled care, and he may then discover the cut ends of these nerves, probably where they pierce the fascia lata.

Whilst dissecting the anterior crural nerve, the student will probably come upon an artery (the external circumflex) which courses outwards to wind round the leg between some of the cords of the nerve; if so, the artery had better be touched as little as possible at present.

When the femoral artery and vein and the anterior crural nerve are cleaned, the floor of Scarpa's triangle will be fairly in view. Whatever connective tissue still remains to obscure its floor must be carefully removed from the subjacent muscles. The iliacus is the most external, and underlies the anterior crural nerve; next to it, underlying the femoral artery, and therefore invisible at present, is the psoas; and underneath the femoral vein, and to its inner side, the pectineus. Lying on this muscle, a small artery (the deep external pudic) runs transversely, and should have been found in the course of the dissection. If injected, it can be traced to the scrotum. The adductor longus completes the boundaries of the triangle.

On the inner side of the vein some more femoral glands, similar to those which were seen in the saphenous opening, will be seen, and may now be removed.

If the body is an ill-developed one, between the pectineus and adductor longus, especially if the outer border of the pectineus be pulled inwards, will be seen

a small nerve, the anterior branch of the obturator. No further notice need be taken of it at present.

This is a good opportunity to finish the verification of the coverings of femoral hernia.

At the inner side of the femoral vein, if the student push his little finger under Poupart's ligament he can generally force a small hole into the abdominal cavity. If the abdomen is opened, he can put his hand on the opposite side into the abdominal cavity, and he will find there is nothing between his two fingers but some peritoneum and subperitoneal fat (septum crurale). This weak spot through which his little finger has penetrated is where a femoral hernia descends; three of its coverings have already been verified before the fascia lata was removed, and, of the remaining three, the crural sheath has been broken through, and the subperitoneal fat and peritoneum are under his finger.

When the student's finger has been passed into the hole on the inner side of the femoral vein, he will feel, below a piece of the bone, the ilio-pectineal line (internally, a sharp edge (Gimbernat's ligament), above an edge not quite so sharp (Poupart's ligament), and externally, septum), that portion of the femoral sheath which separates his finger from the femoral vein.

This aperture, the boundaries of which have just been enumerated, is termed the crural ring, and the continuation of the edges of this ring as far as the saphenous opening, which has been cut away during the dissection, is called the crural canal. The upper part of the crural ring is sometimes strengthened by a thickened fibrous band (part of the fascia transversalis) called the deep crural arch; Poupart's ligament is sometimes called the superficial crural arch.

The crural sheath is formed by the protrusion of a portion of the fascia that lines the abdomen, in the shape of a funnel, the sheath at the apex of the

funnel becoming continuous with the sheath of the femoral artery and vein and the saphenous opening. This funnel-shaped process of fascia is divided by two partitions into three separate canals. The outer contains the femoral artery, the middle contains the vein, and the internal transmits the lymphatics of the leg into the abdomen. It generally contains a lymphatic gland, and constitutes the *femoral* or *crural* canal. It therefore follows that each of these three structures may be looked upon as being surrounded by subdivisions of the large funnel (femoral sheath).

If the abdomen has not been opened when the student reaches this stage of his dissection, he must wait until it is in order to verify the deeper parts of femoral hernia which have just been described.

DISSECTION OF MIDDLE AND LOWER THIRDS OF THIGH.

List of Structures.

Saphenous vein.	Long saphenous nerve.
External, Middle, Internal } cutaneous nerves.	Femoral artery and vein, and their branches.
Patellar and obturator plexuses.	Hunter's canal (length, boundaries, and contents).
	Muscles of thigh.

The skin must be removed exactly in the same manner as it was in the upper third of the thigh. An incision must be continued along the line of the superficial femoral artery as far as the inner edge of the tibia, and a transverse incision made half round the limb at its lower end.

In the superficial fascia the saphenous vein will be easily traced downwards, passing behind the knee, and receiving several unnamed tributaries.

The external, middle and internal cutaneous nerves will likewise be easily traced down, having been

found in the upper third. When they have been cleaned, they will be seen to form a plexus over the patellar, which is joined by a branch (nervus cutaneus patellæ) of the internal saphenous. The saphenous nerve, which comes from the anterior crural, does not pierce the fascia lata until it reaches the lower third of the thigh, where it can generally be found without much difficulty emerging from beneath the sartorius muscle and lying behind the saphenous vein.

The branch which comes forward to join the patellar plexus often perforates some of the fibres of the sartorius muscle.

Close to the nerve plexus, also lying over the patella, is an arterial anastomosis; but this will be dissected later on.

After the patellar plexus is completed, it can be cut away, care being taken not to injure the main trunk of the internal saphenous nerve, and the rest of the superficial fascia can be removed, care being taken not to injure the patellar arterial anastomosis, or the branches which go to form it.

The fascia lata must then be removed over the same area as the skin, and by similar incisions, but the arterial anastomosis must be preserved. The student will observe that the fascia is inserted into the sides of the patella, thus helping to keep it in its place.

The muscles of the front of the thigh will then be all exposed, and the remainder of the femoral artery and vein will be easy to get at. In tracing the muscles care must be taken not to cut away any of the nerves which enter them.

The sartorius must first be followed downwards quite to the lower end of the skin incision, where it will be found to be inserted into the inner border of the tibia. It is best to clean portions of it at a time, and not to attempt to strip off its sheath all at once.

The student must be careful to notice that it crosses the femoral artery at the apex of Scarpa's triangle, and then lies on its inner side, instead of its outer.

In the centre of the thigh below Scarpa's triangle will be seen the rectus muscle, passing down to be inserted into the patella, and on either side the vastus externus and internus, which are also inserted into the patella and tendon of the rectus. These must all be carefully cleaned in the direction of the muscle-fibres, and for this purpose the sartorius will require to be lifted up, in order that the connective tissue on its under surface may be removed. When the branch which enters it from the anterior crural nerve has been found, it had better be cut away, and likewise the small veins and arteries that supply it. In fact, the student may take it as a general rule that all veins in the leg, with the exception of such large ones as the femoral profunda and popliteal, should be cut away during the process of cleaning.

Arising on the outer side of the iliac crest, just outside the sartorius, is the tensor vaginæ femoris, lying between the layers of the fascia lata. If the student attempts to clean this, he will find that about four or five inches from its origin it is inserted into the fascia lata; or, more properly speaking, the thickened fascia lata at the side of the leg, which is known as the ilio-tibial band, forms its tendon.

If this thick fascia lata be traced downwards, it will be found to be attached in front, as has been already mentioned, to the side of the patella; farther back, to the side of the tibia (ilio-tibial band); whilst more behind still, it is continuous with the deep fascia of the back of the leg.

When this is finished, the farther course of the femoral artery must be traced.

The sartorius has already been so cleared that the superficial femoral artery is almost exposed. The

connective tissue which surrounds it must be carefully dissected off. About an inch below the apex of Scarpa's triangle some dense white fibres, transverse in direction, and quite different from its mere connective-tissue covering higher up, will be seen running across the artery from the vastus internus to the adductors. If these are carefully cleaned, they will be found to extend down the thigh some four or five inches. Their lower edge is usually well marked, and from under them at this point a nerve (the long saphenous) will be seen emerging, and should be traced onwards to where it runs alongside of the internal saphenous vein.

Just at the lower end of Hunter's canal a branch of the saphenous nerve can be traced, if the dissector is careful, running to join with a small one from the obturator nerve, and likewise with a branch from the internal cutaneous nerve, to form a small plexus, which has received the name of the obturator plexus.

Hunter's canal.—The fibres which have just been described will be seen to extend from the vastus internus to the adductor longus, which is already cleaned, and also to a muscle lying under it, the adductor magnus, which is not yet cleaned. They form the roof of Hunter's canal, and if they are carefully divided, the saphena nerve will be first brought into view, then the femoral artery, and behind and to the outer wall the femoral vein. Hunter's canal will be seen to be, roughly speaking, triangular in shape, and bounded externally by the vastus internus, internally by the adductor magnus and longus, and to be roofed in by the fascia, which has just been described. At its lower end the femoral artery and vein disappear from view on the front of the leg, as they perforate the adductor magnus, and henceforth become the popliteal.

Just before passing through the adductor magnus, the femoral artery gives off a branch, the anastomotica magna, which almost immediately divides into two branches; a superficial, which can be seen to accompany the internal saphenous nerve, and help to form the patellar anastomosis, and a deep branch. The latter runs down in the substance of the vastus internus in front of the tendon of the adductor magnus, and in order to trace it, some fibres of the vastus must be cut away. Its ultimate distribution to anastomose with the articular branches of the popliteal artery, must be left until a later stage of the dissection.

The only other branches which the superficial femoral gives off are muscular.

When these branches have all been dissected, the adductor magnus must be cleaned, so far as it conveniently can be. On its inner side a thin ribbon-like muscle (the gracilis) will be seen, which must be cleaned, from its origin on the pubes to its insertion on the inner side of the tibia just below the sartorius. Great care must be taken to avoid cutting away the nerves which supply these muscles. Small injected arteries usually form guides to the places where they enter the muscles.

Dissection of the profunda femoris and branches.—This part of the dissection can be either proceeded with at once, or the front of the leg below the knee, with the dorsum of the foot, may be finished first.

List of principal additional Structures to be seen during this part of the Dissection.

- Removal of tensor vaginæ femoris from origin.
- Exposure of external circumflex arteries.
- Reflection of adductor longus, brevis, and pectineus, and exposure of internal circumflex and three perforating arteries.
- Obturator nerve and branches.
- Obturator artery.
- Obturator externus muscle.

If the student has not already done so, he must now dissect carefully between the tensor vaginæ femoris and the sartorius, keeping quite close to the former muscle. He must then pull the tensor femoris a little away from the leg, and cut it away from its origin, leaving none of it attached to the outside of the ilium.

When this is finished, the connective tissue and fat must be carefully dissected from the outside of the vastus externus, and the place where it comes forward to take origin from the front surface of the femur clearly defined.

When the tensor fasciæ femoris is cut away, its nerve (a branch of the superior gluteal) will be found coming forward between the gluteus mėdius and minimus, and must be taken care of, as it has to be dissected with the muscles of the gluteal region. At present it serves to indicate the separation between the gluteus medius and minimus.

Next trace the rectus up to its origin; both its heads can be easily dissected now that the tensor fasciæ femoris is cut away.

It has already been mentioned (in the dissection of Scarpa's triangle) that the external circumflex artery courses between the branches of the anterior crural nerve. It must now be traced outwards. To do so, the sartorius must be pulled with hooks, if necessary, to the inner side of the leg, and the fascia cleaned from underneath the rectus, care being taken not to cut away the branch of the anterior crural nerve, which enters its under surface at about the thickest part. The external circumflex artery can then be easily traced under the rectus, just outside which it divides into three branches, an ascending, transverse, and descending. The transverse passes underneath the vastus externus, lying upon another muscle (crureus), which is now exposed. If it is traced on

farther, it will be found to lie between the vastus externus and the femur, and finally perforate the vastus to reach the back of the leg, where its termination will be seen in the dissection of the back of the thigh. The descending branch can be traced downwards, between the vastus externus and crureus, to enter the lower part of the vastus externus, along with a branch of the anterior crural nerve. The fibres of the vastus externus may afterwards be divided, in order to trace the continuation of the artery, and its anastomosis with the superior external articular branch of the popliteal, which has yet to be dissected.

The ascending branch must be traced upwards beneath the tensor fasciæ femoris, where it anastomoses with the gluteal.

In order to fully expose the remaining branches of the profunda, the adductor longus and pectineus should be cut away from their origins and turned downwards, and the femoral artery and vein pulled to the outer side of the leg with hooks. On the under surface of the adductor longus, and lying on the adductor brevis, will be found the anterior division of the obturator nerve. It sends branches to the adductor longus and gracilis, and nearly always to the adductor brevis, pectineus, and hip-joint. If there is an accessory obturator nerve it will be found towards the outer side of the pectineus, closely underlying its fibres, and when traced up a little way will be seen to be coming over the brim of the pelvis, and not through the obturator foramen.

When the under surfaces of these muscles are cleaned, at the outer margin of the pectineus a good-sized branch of the profunda (the internal circumflex) will be seen; it passes backwards between the psoas and pectineus. Before tracing it farther, a little more dissection must be completed.

Underneath the adductor longus will be seen the adductor brevis, upon which the anterior division of the obturator nerve lies. This muscle must be carefully cleaned, and turned downwards from its origin, when the obturator externus will be seen hiding the obturator foramen and obturator artery from the view of the dissector.

The remainder of the internal circumflex, so far as it can be traced from the front of the leg, can now be easily cleaned.

Like the external circumflex, it will be seen to divide into three branches; one, which may be considered to be its continuation, passes back transversely, lying on the obturator externus, to arrive at the back of the leg. The ascending branch runs along the upper border of the adductor brevis to the pubes. The descending branch runs downwards with the posterior division of the obturator nerve upon the adductor magnus. These branches, however, are not nearly so distinctly marked as those of the external circumflex.

When the adductor brevis is turned down, the posterior division of the obturator nerve, piercing the obturator externus, will be clearly brought into view, and should be traced as far as possible. The branch to the hip-joint and obturator externus will not yet be traceable; but the branches of the anterior division to the pectineus and adductor brevis have already been seen, and those to the adductor longus and gracilis can be easily followed if the nerve is carefully dissected from above downwards.

The posterior branch, on the deep surface of the adductor brevis, is distributed mainly to the adductor magnus, and sends a large branch to the obturator externus.

The branch to the adductor magnus enters that muscle about the junction of the upper and middle

thirds of the thigh, and sends a small branch down in the substance of the muscle, which usually emerges at the opening in adductor magnus made by the femoral artery, and is then found in the popliteal space. This branch is not easily seen, unless a special dissection is made for it in a part which has been preserved in spirit. To follow its course the trunk of the nerve should be found above, and followed through the adductor from above downwards by cutting away its fibres. It enters the knee with the azygos artery.

The pectineus, adductor longus and brevis, must now be replaced in position; and on the under surface of the profunda femoris, when it is pulled upwards and to the outer side of the leg by hooks, three or four arteries (the perforating) will be seen.

These can be easily traced to perforate the adductors, and so reach the back of the thigh.

The three upper arteries vary somewhat, but usually run as follows: The middle perforates both the adductor brevis and magnus, the upper perforates the adductor magnus above the adductor brevis, and the lower one perforates it below the adductor brevis.

The fourth perforating is often spoken of as the terminal branch of the profunda, and usually perforates the adductor magnus close to the opening for the femoral artery, and ends in the second head of the biceps.

The student must not be in the least surprised to find variations from the above description, as the internal, and sometimes the external circumflex, come off from the common femoral, or the perforating arteries may be fewer in number.

The **front of the thigh as a whole.**—Now that the principal structures in the front of the thigh have been exposed, they must be studied as a whole, but nothing should be cut across except what has

already been done, otherwise it will not be easy to learn the relations of the various structures.

The muscles will be seen to consist of two groups, each of which has separate functions.

On the inner side of the thigh are the adductors, supplied by the obturator nerve, which also sends a branch to the pectineus. This muscle receives its principal nerve-supply from the anterior crural, since it belongs to that group of muscles which flex the thigh upon the abdomen, and which comprise in addition the psoas, iliacus, and muscles forming the quadriceps extensor femoris, viz., the two vasti, the rectus, and crureus.

Sometimes, the vastus internus and crureus being blended below, are spoken of as one muscle, but it seems simpler to refer to them as separate ones.

The course and relations of the femoral and profunda arteries and veins must be carefully studied and re-studied, and the origin, insertions, and exact nerve-supply of the muscles learnt. When this has been done, the thigh should be carefully covered up, either with its own skin or with some gutta-percha tissue, and kept for future reference, for it needs to be *many times* gone over before it can be thoroughly mastered.

DISSECTION OF FRONT OF LEG AS FAR AS ANKLE.

List of Surface Markings.

Spine and tubercle of tibia.	Malleoli.
Tuberosity of tibia.	Line of anterior tibial artery.
Head of fibula.	

The bony prominences around the head of tibia were felt before the thigh was dissected. If the fingers are passed down the inner side of the leg below the knee, the tibia will be felt to be subcutaneous the whole way down to the ankle, and will

be found to terminate in the internal malleolus. A little behind the internal malleolus, on the outer side of the leg, is the outer malleolus (or lower end of the fibula), and stretching up from it the subcutaneous surface of the fibula.

A line drawn from the inner side of the head of the fibula above down to a point midway between the internal and external malleoli, will indicate the line which the anterior tibial artery takes.

List of Structures to be Dissected in Front of Leg.

Internal saphenous vein and nerve.
External saphenous vein and nerve (a few small branches).
Musculo-cutaneous nerve.
Deep fascia and annular ligament.
Tibialis anticus.
Extensor longus digitorum.
Extensor longus pollicis.
Peroneus tertius.
Peroneus longus.
Peroneus brevis.
Anterior tibial artery, veins, and nerve, and branches.
Anterior peroneal artery.

Make an incision down the leg in the line of the anterior tibial artery, cutting through the skin, and a transverse one at its lower end, from one side of the leg to the other. Reflect the skin, taking care, as in the case of the thigh, to leave the subcutaneous fat, etc., behind.

Trace downwards from the thigh the internal saphenous vein and nerve, to the front of the internal malleolus.

Towards the outer side of the leg some veins will be found, which are winding round towards the back of the leg ; they are going to join the posterior (or external) saphenous vein, which will be dissected with the back of the leg.

In close company with these will be found, if careful search be made, some small nerves which are branches of the external saphenous nerve.

Midway between the spine of the tibia and the

fibula, and about midway also between the knee and ankle, a good-sized nerve will be seen, if search is made, in the subcutaneous tissue. This is the musculo-cutaneous, which divides usually into two branches before it reaches the front of the ankle. Besides these nerves, there may be numerous small unnamed arteries supplying the skin and subcutaneous tissue.

When these structures have been discovered, the subcutaneous tissue should be carefully cleaned off the leg, and the deep fascia with the subcutaneous portions of the bones covered by periosteum will be exposed. The deep fascia is a thick dense membrane, and will be seen to be attached above and on either side to the tibia and fibula, gradually thinning as it descends; when it reaches the front of the ankle it suddenly forms a thickened band (the anterior annular ligament), which runs across from one malleolus to the other.

The whole of this deep fascia must be carefully dissected off the subjacent muscles, which are very firmly attached to it, taking care not to cut away the internal saphenous nerve and vein and the musculo-cutaneous nerve. In order to avoid the latter, it is perhaps best to begin at the outer border of the sub-cutaneous surface of the tibia, and making an incision just through the fascia, seize the cut edge with forceps, and carefully clean the muscle underneath (tibialis anticus) in the direction of its fibres. When the outer edge of this muscle is reached, the fascia will be found to dip downwards, showing that it forms, as has been often before stated, a distinct skin for the muscle.

As the upper part of the tibialis anticus is reached, it will be found much more difficult to clean the fascia from the muscle, as some of its fibres actually take origin from the fascia.

The remaining muscles which pass in front of the ankle-joint must be cleaned exactly in the same

manner. They are, in order from within outwards: tibialis anticus, extensor longus pollicis, extensor longus digitorum, and, arising lower down from the fibula, and forming part of the last muscle, the peroneus tertius. The muscles attached to the fibula, the peroneus longus above, and brevis below, are next to be dissected. They are not so easy to clean, as the fibres, particularly of the peroneus longus, run somewhat obliquely, and so the fascia must be carefully removed in the direction of their fibres.

When these muscles are cleaned their origins from the bones should be learnt, and compared with what the student has previously learnt on his bones.

To expose the anterior tibial artery, the tibialis anticus must be separated from the extensor longus digitorum and pollicis. This is best effected by making traction on their tendons in the lower part of the leg, when the separation between the muscles will be easily seen, if it has proved to be difficult to make out previously, or small arteries which emerge between the muscles will serve as guides.

The process of cleaning will probably have already displayed the anterior tibial artery below, near the annular ligament, where it becomes subcutaneous. It can be easily traced upwards from this point, and when the above-named muscles are separated, will be found to lie on the interosseous membrane which unites the tibia and fibula. Two venæ comites will be found with the artery. The anterior tibial nerve also accompanies it, and in the upper third lies outside the artery, then upon it, and below again is at its outer side. The line of the artery should be carefully compared with its surface marking to see that they correspond.

Branches from the nerve artery and vein can be easily traced to muscles which pass in front of the ankle-joint. A branch of the anterior tibial artery

and nerve will be seen to pass through the tibialis anticus above, to join the patellar plexuses.

By tracing the musculo-cutaneous nerve upwards, it will be seen to pass under the inner side of the peroneus longus, and, if it be traced through the fibres of this muscle as far as the head of the fibula, it will be seen to give off muscular branches, to supply the peroneus longus and brevis.

Before going farther the student should look for the small anastomosing branches in front of the ankle, which can be seen at this stage; they come from the anterior tibial. Under the outer border of the peroneus tertius is usually seen the anterior peroneal, which perforates the interosseous membrane from behind, and is the continuation of the peroneal artery.

These branches can be left for the present, and the whole anastomosis round the ankle dissected at a later stage.

The whole of the leg below the knee must be learnt by the aid of some work on descriptive anatomy, and the thigh again gone over. The student will learn a great deal by showing his part to his friends, and losing no opportunity of seeing each structure, especially the smaller ones, upon as many bodies as possible. By this means he will gain great advantages in a large dissecting-room, as he will often see on a friend's part that which he has cut away on his own.

THE DORSUM OF THE FOOT.

List of Surface Markings.

Outline of os calcis.
Peroneal tubercle.
Base of metatarsal bone of little toe.
Tubercle of scaphoid.
Base of metatarsal bone of great toe.
Outlines of metatarsal bones and phalanges.
Line of dorsalis pedis artery.

By passing his finger round the heel to its back part, the student will easily feel the outline of the os calcis; as he comes forward, just below the outer malleolus, he can feel a small prominence of bone (peroneal tubercle) between the tendons of the peroneus longus and brevis; this is better marked in some people than in others. Some little distance down the outer border of the foot there is a very well-marked prominence, the base of the metatarsal bone of the little toe.

The tubercle of the scaphoid is one of the most important landmarks on the inner side of the foot. It is situated about two inches in front of the inner malleolus, and is a guide to the transverse tarsal joint. About an inch in front of it is the base of the metatarsal bone of the great toe.

The outlines of the metatarsal bones and phalanges are well marked, except on the fattest feet, and need no further description.

A line drawn from midway between the two malleoli, to the middle of the cleft between the great and second toe, will mark out the course of the dorsalis pedis artery.

List of Structures to be Dissected on Dorsum of Foot and in Front of Ankle.

Cutaneous Nerves:
- Internal saphenous.
- External saphenous.
- Anterior tibial.
- Musculo-cutaneous.

Internal saphenous veins.

Annular ligament, and the tendons, etc., which pass beneath it.

In order from within outwards:
- Tibialis anticus.
- Extensor proprius pollicis.
- Anterior tibial artery and veins.
- Anterior tibial nerve.
- Extensor longus digitorum.
- Peroneus tertius.

Extensor brevis digitorum.

Dorsal interossei.

Dorsalis pedis and branches.

Make an incision in the line of the dorsalis pedis artery, as far as the base of the cleft between the

great and second toe, and a transverse incision across the bases of the toes.

An additional central incision should be made down one or two of the toes. The internal saphenous vein is easily seen, forming an arch over the base of the metatarsal bones, and should be followed outwards until it joins the external saphenous below the outer malleolus.

The internal saphenous nerve must next be traced to its destination on the ball of the great toe, and the two branches of the musculo-cutaneous to supply the inner side of the great toe, and the second, third, and fourth clefts.

The first cleft is supplied by a branch of the anterior tibial, which becomes cutaneous at the base of the cleft. With a little care it can be found by scraping carefully at the base of the cleft or on the outer side of the great toe.

If the student fail to find it in this way, he will be obliged to wait till he has traced the anterior tibial downwards to this point.

On the outer side of the foot, close by the external saphenous vein, will be found the external saphenous nerve, which supplies the outer side of the little toe and outer side of foot.

If possible, cutaneous nerves and veins should not be cut away, as they are a little complicated, and therefore difficult to learn.

The subcutaneous fat and areolar tissue should be all carefully cleaned away, and the deep fascia exposed. The thickened part of this fascia, which forms the annular ligament above the ankle, has already been dissected and preserved; there is another portion of the annular ligament below the ankle. This portion of the so-called annular ligament is Y-shaped. The tail of the Y is attached to the upper surface of the os calcis. The upper limb of the Y to the internal

malleolus, the lower to the scaphoid bone and fascia at the inner side of the foot.

When this is completed, the deep fascia must be removed from the dorsum of the foot, beginning on one side, and taking it carefully off towards the other.

Its removal will expose a further portion of the tendons belonging to the muscles of the front of the leg, which should be continued to their insertions.

At the same time a small muscle (the extensor brevis digitorum) will be seen arising from the upper surface of the os calcis, and passing onwards to be inserted into the fibular side of the first phalanx of the great toe, and into the three next extensor tendons. When the muscle and the extensor tendons are completely cleaned, the dorsalis pedis artery, which is the continuation of the anterior tibial, will be seen to run on a deeper plane. It is first seen coming from under the annular ligament, between the extensor longus digitorum and extensor proprius pollicis, and if any difficulty is experienced in finding, it can be readily made out by pulling on the anterior tibial. When once it has been found, it can be traced to the first cleft, where it descends to join the deep plantar arch, which will be seen when the sole is dissected.

Outside the anterior tibial artery will be found the corresponding nerve, which divides into a superficial and a deep branch. The deep branch should be traced into the extensor brevis digitorum, the superficial into the first cleft.

There will be no difficulty in tracing branches from the dorsalis pedis artery across the tarsal and metatarsal bones, and making out the digital branches if they are injected; if not, a little more care is necessary to trace them; but the student must remember that they all lie on a deeper plane to the tendons and extensor brevis digitorum.

In between the metatarsal bones the dorsal interossei muscles are seen when the fascia which covers them is removed. They cannot be at present traced to their insertions.

The dorsum of the foot having been learnt so far, must be covered up with its own skin, or with some guttapercha tissue, so as to keep it moist and available for future inspection.

Dissection of buttock and back of thigh.—Place the body on its face, and raise the pelvis some two feet from the table with blocks, so that the legs hang downwards. The legs should be crossed, so as to make the skin and underlying structure tense.

Surface Markings.

Crest of ilium.	Coccyx.
Posterior superior spine of ilium.	Tuberosity of ischium.
Spines of sacral vertebræ.	Great trochanter of femur.
	Fold of buttock.

The crest of the ilium has already been felt from the front: there will be no difficulty, therefore, in finding it behind, and tracing it round as far as its termination in the posterior superior spine, of course with a bone at hand as well.

In the middle line of the body the spines of the sacral vertebræ will be felt, and just above the anus the coccyx, which can usually be felt to be movable.

On either side of the anus, the two prominences of bone (ischial tuberosities) on which the body rests in the sitting position, will be very well seen, and more easily felt.

Outside these again, and a little above them, quite at the outer side of the leg, the great trochanter of the femur must be felt. Stretch a piece of string from the anterior superior iliac spine in front, to the ischial tuberosity behind, it will be found to pass directly over the great trochanter. This is called

Nélaton's line, and is of the greatest importance in detecting any change in position in the upper end of the femur, either from injury or disease.

In most bodies a well-marked depression is observable, curving outwards from the coccyx. It denotes the line of the buttock. Its absence during life is indicative of disease.

Structures to be Dissected in Gluteal Region.

Cutaneous nerves (dorsal, lumbar, and sacral, including lesser sciatic).
Gluteus maximus.
Gluteus medius and minimus.
Pyriformis.
Gluteal vessels and nerves (above pyriformis).
Sciatic vessels and nerves, and nerve to obturator internus, Pudic vessels and nerves, } below pyriformis.
Gemelli.
Obturator internus and externus.
Quadratus femoris.
Adductor magnus.
Origins of hamstrings.
Terminations of external and internal circumflex arteries helping to form the crucial anastomosis.
Superior perforating artery.
Greater and lesser sacro-sciatic ligaments.
Bursæ.

Skin incisions must be made from the anterior superior spine of the ilium along the crest to the spinous process of the last lumbar vertebra. From this point downwards to the tip of the coccyx, and then downwards and outwards to the outside of the leg along the fold of the buttock.

The skin should be carefully seized, and reflected outwards in one piece. When this is done a large amount of fluid will probably be seen in the subcutaneous tissue, owing to the body having lain for some time on its back. This renders the dissection of the superficial fascia difficult and dirty. In an old body it is sometimes advisable to clean this off in one piece, without attempting to hunt for superficial vessels and nerves; but on this point the student should consult his teacher. This fluid infiltrates the

deeper parts as well, and renders the dissection of this part always difficult.

In a good body the student may expect to find a branch of the last dorsal, two or three lumbar, *i.e.*, iliac branches of the ilio-inguinal and ilio-hypogastric (*vide* Fig. 15), three sacral branches from the sacral foramina, and branches from the lesser sciatic, which curl up round the lower border of the gluteus maximus.

It is impossible to give any very definite directions for finding the nerves. To search for them the student should begin at the outer side of the iliac crest, and, carefully removing the superficial fascia in a series of thin layers by vertical cuts, and scraping with the point of his knife, he will discover the last dorsal nerve about the junction of the anterior with the middle third of the ilium; an inch or two farther back and he will come upon iliac branches from ilio-inguinal and ilio-hypogastric. When these are found he must go slightly to the inner side of the posterior superior spine, and about midway between it and the sacral spines the three small sacral branches lie. If the body is well injected, three small arteries will possibly form a guide to their whereabouts; if not, they can only be found by careful scraping and dissection. They are very small, and easily overlooked.

Along the fold of the buttock some branches of the small sciatic ascend. They are the easiest of all the nerves of this region to find. If the student scrape and dissect about the middle of this fold he ought to find one branch, and then he will easily trace the others. Sometimes an artery is present as a guide.

As soon as these nerves are found, or the student thinks he has expended enough time and patience on the search, the superficial fascia must be taken off in one piece, and the gluteus maximus exposed. It is a large coarse muscle, and very difficult to clean; in fact, it is only possible to clean it by taking the fascia

off each fibre separately. When it is cleaned the gluteus medius will be seen appearing from beneath its front margin covered with a dense fascia prolonged from the fascia lata of the leg. Beginning from where it touches the gluteus medius, the maximus must be cut through about three-quarters of an inch from its origin, and reflected downwards and outwards towards the great trochanter.

The gluteal vessels and nerves (inferior gluteal from lesser sciatic) which enter it on its deep surface must be cut away close to the muscle to facilitate the process of reflection, and its insertion into the fascia lata made out.

The gluteus medius should next be cleaned and reflected partially from its origin, like the gluteus maximus.

The principal structures in the gluteal region will then be exposed.

The student will be able to verify the surface markings of the ischial tuberosities and great trochanter which he felt through the skin.

The hamstring muscles will be seen arising from the ischial tuberosity; their exact positions will be made out later on.

A little above the tuberosity, and emerging from under the gluteus maximus, will be seen a muscle (pyriformis) which may be said to form the key to this region.

Dissect it first, cleaning off its fascia in the direction of its fibres, and tracing it as far as the great trochanter, where it is inserted. Its origin cannot yet be seen, as it is inside the pelvis.

When this muscle is well cleaned, the structures which come out from the pelvis above and below it must be made out. Various arterial branches can be seen; those above it are gluteal arteries, and those below, sciatic arteries. The gluteal arteries are traced

to all the neighbouring muscles, etc., whilst the sciatic is small, and runs down to be lost on the back of the thigh.

Accompanying the gluteal artery are venæ comites, and branches of the superior gluteal nerve, which should be traced beneath the gluteus medius, and to the gluteus minimus. It runs along on the outside of the gluteus minimus, just at its upper part, and between it and the gluteus medius, to end in a small nerve to the tensor fascia femoris, which was seen during the dissection of the front of the thigh.

At the lower border of the pyriformis will be seen the great sciatic nerve, which is as thick as one's little finger; and close beside it, usually on its inner side, the small sciatic nerve, the branches of which to the gluteus maximus and skin have already been severed.

Farther internal, and deeper down, another nerve and artery will be seen if a little cleaning is done. These are the pudic nerve and artery, and close by them is another small nerve to the obturator internus. These last three lie on the spine of the ischium, and ought to be traced under the great sacro-sciatic ligament through the lesser sciatic notch into the ischio-rectal fossa. To do this, the remains of the gluteus maximus, which was left behind at its origin from the sides of the sacrum and coccyx, may require to be cut away, and under it a large ligament, the great sacro-sciatic, will be seen pierced by a small artery.

Accompanying this artery is a small nerve, which helps to form a plexus, the coccygeal, which is dissected with the ischio-rectal fossa. (*Vide* page 130.)

Emerging from underneath the great sacro-sciatic ligament the pudic vessels and nerve will be seen in the ischio-rectal fossa. (*Vide* Dissection of perinæum, page 131.) The lesser sacro-sciatic ligament stretching from the ischial tuberosity must be dissected at the same time.

During the process of cleaning the sciatic nerve, some muscles which underlie will be brought into view ; they must now be dissected. Beginning from above downwards they are as follows : Obturator internus, with the gemellus superior above it, and the gemellus inferior below ; after which come the quadratus femoris and the adductor magnus.

These muscles must all be cleaned as far as the surroundings will permit it, care being taken not to injure the small anastomosing arteries, which have next to be dissected.

Coming out between the adductor magnus and quadratus femoris is a branch of the internal circumflex artery ; it must be traced to anastomose with the external circumflex, which has already been seen on the front of the leg, and may now be seen before any dissection is attempted on the outside of the femur. A branch from the gluteal and sciatic can be traced down to these, and another up from the superior perforating branch of the profunda femoris. To this anastomosis the term crucial has been applied. There is very often quite a network of anastomosis on the back of the great trochanter, and in the digital fossa.

The nerve supply of all the muscles, except pyriformis, gemelli, and quadratus femoris, has now been seen. The nerves to the pyriformis lie inside the pelvis, and so must be dissected from the inside. The nerves to the quadratus femoris and obturator internus pass out of the pelvis by the great sciatic notch. That to the quadratus passes beneath the tendon of the obturator and gemelli, lying on the capsule of the hip and upon the ischium. It enters the front surface of the muscle, and to find it the great sciatic nerve should be drawn towards the great trochanter of the femur, the quadratus femoris and inferior gemellus separated, and the nerve sought for close to the tuberosity of the ischium. When it has been found,

branches may be traced from it into the inferior gemellus and capsule of the hip. The nerve to the obturator internus, after leaving by the great sciatic notch, enters the pelvis again by the lesser, and supplies the muscle within the pelvis. Before passing through the lesser sciatic notch it lies almost in contact with the gemellus inferior and gives a branch to it. The student need not be very much disappointed if he does not see them, as they are easily overlooked.

DISSECTION OF BACK OF THIGH.

Surface Markings of Back of Thigh.

Great sciatic nerve.
Popliteal artery.
Hamstring tendons.
Peroneal nerve.

A line drawn from midway between the greater trochanter and ischial tuberosity to the middle of the back of the knee (the ham), will represent the line of the great sciatic nerve. The popliteal artery runs almost in the same line, from about four inches above the knee-joint down to about three inches below it. Just above the knee, on the outer side, the tendon of the biceps and peroneal nerve will be readily felt, and on the inner side of the knee the semimembranosus, with the semitendinosus outside it; these are especially noticeable on the living body.

List of principal Structures to be Dissected on the Back of the Thigh.

Lesser sciatic nerve.
Great sciatic nerve, dividing into external and internal popliteal.
Sciatic artery.
Semimembranosus.
Semitendinosus and biceps.
Adductor magnus (back surface).
Popliteal artery and vein and branches.
Perforating vessels
Short saphenous vein.
Lymphatic glands.
Origins of gastrocnemius and plantaris.
Bursæ.

An incision must be made through the skin in the line of the great sciatic nerve as far as the knee, and a transverse incision must be made about two inches below the joint at its lower end. The skin having been reflected, and the lesser sciatic nerve traced downwards, it will be seen to give cutaneous branches to the whole of this region. A few small twigs come round from the external and internal cutaneous nerves, but these will not be found unless they are traced from the nerves themselves on the front. The cutaneous arteries and veins are unimportant, and are derived from those in the neighbourhood; sometimes a superficial vessel can be traced down with the small sciatic nerve. The deep fascia will be readily exposed by the removal of the superficial; and the hamstrings, semimembranosus, semitendinosus, and biceps, will come into view. They must be cleaned and dissected away from the adductor magnus, which is on their deep surface. In doing so, care must be taken not to cut away their nerves, which can be very easily found, and traced back to the great sciatic nerve, which next comes into view.

These muscles must be very carefully dissected out above, so as to see their exact relative position on the ischial tuberosity, and they must be all traced to their insertions; the semitendinosus has, very probably, been seen at its insertion on the front of the leg. The handle of the knife should be pushed beneath the heads of the gastrocnemius, and the muscle raised to show the synovial bursæ beneath them. They communicate with the knee-joint, and that to the inner head of the gastrocnemius is prolonged beneath the semimembranosus. This is a good opportunity to run over the other bursæ round the knee, viz., those beneath the popliteus, biceps, and about patella. Where the hamstrings diverge below, they enclose a space called the popliteal space, or ham, the contents

of which need be dissected well, as they are very important. The small sciatic nerve has already been traced across it, and must be held out of the way with hooks to expose its deeper parts.

The student must begin at one side and carefully turn out the contents; he will readily learn the whereabouts of the external and internal popliteal nerves (branches of the great sciatic), by pulling on the sciatic. A vein (the short saphenous) will be seen coming up the back of the calf to dip down deep in the space, and join the popliteal vein, but only the upper two inches of it will be seen at this stage. Close to it several (four or five) lymphatic glands are usually seen. Their position should be carefully noted, as they are liable to become inflamed in any affection of the back of the leg and heel. The popliteal artery and vein can hardly be missed, and must be cleaned.

On the deep surface of the popliteal artery is the branch of the obturator to the knee-joint, as was stated during the dissection of the rest of that nerve on the front of the leg.

The upper ends of the gastrocnemius and plantaris will have been brought into view as far as the lower boundaries of the popliteal space; they, too, should be cleaned as far as they are exposed, care being taken not to cut away the arteries and nerves which supply them.

The back surface of the adductor magnus is to be cleaned, during which process the perforating arteries which pierce this muscle will be seen, and must be dissected. If well injected, they are readily seen to form a complete chain of anastomosis, stretching from the circumflex above to articular branches of the popliteal below. These latter branches, easily seen on the sides of the popliteal, must be carefully traced round to the front of the leg, where they all

anastomose on the front of the patella, and join with the recurrent tibial to form the patella anastomosis, which has already been dissected. To follow them completely, it is necessary to cut across the hamstrings and part of the vasti ; but it is better not to do this at present, but rather to be content with the somewhat limited view that is obtained by pulling these muscles aside.

BACK OF LEG AND INNER ANKLE.

Surface Markings.

Prominence of heel.	Line of peroneal and posterior tibial arteries.
Tendon of gastrocnemius (tendo Achillis).	

The prominence of the heel which is formed by the os calcis needs no mention ; its situation is obvious. The tendon of the gastrocnemius, tendo Achillis, can be readily felt running up for several inches from the heel, and is best felt on the student's own body.

A line drawn from midway between the two condyles of the femur to midway between the inner malleolus and the inner edge of the heel will indicate the line of the posterior tibial artery. The peroneal is represented by a line drawn from the centre of the lower part of the popliteal space as far as the junction of the lower with the middle third of the fibula.

The principal structures to be dissected on the back of the leg are as follows :

External saphenous nerve and vein.	Parts at inner ankle, viz. :
Gastrocnemius.	Tibialis posticus.
Soleus.	Flexor longus digitorum.
Plantaris.	Posterior tibial artery and veins.
Popliteus.	Posterior tibial nerve.
	Flexor longus pollicis.
	Peroneal artery and veins.

An incision must be made through the skin in the line of the posterior tibial artery, and a transverse incision below, and the skin reflected. The external saphenous vein which has been seen in the popliteal space must be traced down and cleaned.

For some little distance down the calf, the small sciatic nerve may perhaps be traceable.

About the middle of the calf, the student will find, by dissecting carefully, the external saphenous nerve, and must follow it down to behind the outer ankle. If he cannot find it in this way, he should carefully trace downwards the external and internal popliteal nerves, and he will find that they each give a cutaneous branch. These two unite usually four or five inches below the knee-joint to form the external or posterior saphenous. The branch from the internal popliteal is usually the larger; it is called the communicans poplitei, whilst the branch from the peroneal is called the communicans peronei. The latter is sometimes absent. Some cutaneous branches from the internal saphenous should be looked for on the inner side of the leg.

The superficial fascia must now be cleaned off, the saphenous nerve and vein being hooked aside and preserved.

The rest of the gastrocnemius and plantaris should afterwards be exposed and cleaned. Immediately underlying the gastrocnemius, and blending with it in the middle of the calf to form the tendo Achillis, is the soleus, which is best displayed by cutting through the heads of the gastrocnemius.

Branches of the popliteal artery and internal popliteal nerve can readily be traced into these muscles. The peroneal or external popliteal nerve should now be followed round the head of the fibula, lying at first internal to the biceps tendon, until it disappears under the peroneus longus

muscle, which will now be seen from the back of the leg.

When the superficial muscles are cleaned, the soleus must be divided close to where it takes origin from the back of the fibula, and the outer head of the gastrocnemius divided close to its origin; these muscles can then be turned over towards the inner side of the leg to display the deeper structures.

This will enable the student to trace the popliteal artery and nerve onwards. At the lower border of the popliteus the artery divides into anterior and posterior tibial. The anterior tibial will be seen to pass forward to the front of the leg under the lower border of the popliteus muscle, which has not been mentioned. The posterior tibial passes, with its nerve, under an aponeurotic arch formed by the soleus. When the soleus has been reflected from its attachments the peroneal artery will be seen given off from the posterior tibial.

After the soleus has been reflected from its attachments to the tibia and fibula, the popliteal nerve (now become the posterior tibial) will be seen running superficial to the artery, like the rest of the large nerves on the back of the leg. It will be seen to lie first inside the posterior tibial artery, and then, just where the peroneal artery is given off, to cross and lie on its outer side.

Usually the structures can be seen as above described without much further dissection, but, at any rate, they should be carefully cleaned as far as the heel, care being taken not to remove the internal annular ligament. With the peroneal artery this is impossible at present, as it runs in the substance of the flexor longus pollicis.

The posterior tibial artery and nerve will be seen when cleaned to give branches to all the subjacent muscles except the popliteus, which receives its

nerve-supply from the popliteal nerve. This nerve is given off high up in the popliteal space, and runs over the popliteus to wind round its lower edge, to end at last in its anterior surface, as will be seen later on.

The posterior tibial artery and nerve should now be hooked a little to one side, and the popliteus, flexor longus pollicis and digitorum, cleaned. When these two muscles are a little separated, they will display the tibialis posticus, which they overlap. After cleaning, and learning with great care the structures at the inner ankle, already enumerated, the peroneal artery may be traced downwards by cutting into the substance of the flexor longus pollicis. At the lower part of the muscle it divides into anterior peroneal and external calcanean. The anterior peroneal pierces the interosseous membrane to appear beneath the peroneus tertius, where it has been already seen. The external calcanean emerges from the lower edge of the flexor longus pollicis to run behind the external ankle, and anastomose with the tarsal branch of the dorsalis pedis and the internal calcanean branch of the posterior tibial, which runs beneath the tendo Achillis. At the lower part of the interosseous membrane a transverse artery should be looked for, joining the posterior tibial and peroneal arteries.

The **sole of the foot.**—By this time the leg will have been removed from the body, and must be placed knee downwards, and the sole turned upwards, and nailed or tied to a block. The surface markings of the sole of the foot present little difficulty. The bony prominences of importance have been already alluded to. (*Vide* page 77.)

The external plantar artery is the chief continuation of the posterior tibial. A line drawn from midway between the inner malleolus and the os calcis to the base of the metatarsal bone of the little toe, will denote its course, until it turns to form the

plantar arch; a line drawn transversely across the sole of the foot, about half an inch in front of the bases of the metatarsal bones, will mark out the line of the plantar arch.

List of Structures to be Dissected on the Sole of the Foot.

Plantar cutaneous nerve and artery.
Cutaneous branches of external and internal plantar artery and nerve.
Plantar fascia, and intermuscular septa.
Abductor pollicis.
Abductor minimi digiti.
Flexor brevis digitorum.
Flexor accessorius.
Long flexor tendons, including peroneus longus, and long plantar ligament.
Lumbricales.
Flexor brevis pollicis.
Flexor brevis minimi digiti.
Adductor pollicis.
Transversus pedis.
Plantar and dorsal interossei.
External and internal plantar arteries, veins, and nerves, and their branches.
Plantar arch (arterial).

The skin of the sole of the foot can be removed in one large flap exactly the size of the sole, by cutting all round its edges. The student will be surprised at the depth he is obliged to cut in order to remove this flap, as the skin of this part of the body is very thick; it must be turned forward as far as the bases of the toes, and cut away, after which the skin must be divided up the centre of each toe and reflected.

Oftentimes the sole of the foot is not in a good condition for dissection by the time the student reaches it. This is owing to the fact that the injection has not reached the vessels of the foot, and thus it is not preserved as well as it should be. On a good foot the structures which are here described will be easily seen.

The first thing to be done is to dissect out the internal annular ligament, the upper border of which has already been defined during the dissection of the leg. It must be traced downwards to see that it is only a thickened portion of the deep fascia, like the anterior annular ligament.

Piercing this ligament will be seen a small branch

of the posterior tibial artery, the plantar cutaneous, and, accompanying it, a small nerve of the same name, which is derived from the post-tibial nerve. This should be traced as far as possible into the sole of the foot.

If the foot is really a good one, some small arteries (plantar cutaneous) will be seen coming through the superficial fascia along two lines, about three-quarters of an inch from the inner and outer sides of the foot. By careful dissection some corresponding nerves from the external and internal plantar respectively will be seen. All these branches are small, and liable to be overlooked.

When the superficial fascia has been removed, the deep glistening dense fascia, *the plantar fascia*, will be seen. It is not at all easy to clean, but can be readily traced covering each of the subjacent muscles. Near the divisions of the toes there will be seen to be some well-marked transverse fibres.

When this fascia is removed by cutting it away from the os calcis and turning it forwards, the three subjacent muscles, abductor pollicis and minimi digiti, on either side, and flexor brevis digitorum in the middle, will be exposed. On either side of this last muscle some branches of the plantar nerve and artery will be seen.

The superficial muscles must be cleaned, examined, and all turned forward like the plantar fascia. In so doing, their nerves and arterial supply will be divided, if care be not taken to look out for the branches of the external and internal plantar nerves and arteries which enter them upon their deep surface.

The posterior tibial artery and nerve can now be seen, as they emerge from under the annular ligament, to divide into external and internal plantar. They must be traced onward some distance.

The internal plantar artery will be seen to run along the inner side of the sole, after which the student must carefully dissect it to see whether it ends in the great toe, or has a more extensive distribution.

The corresponding nerve, which is very much larger than the artery, must be put on the stretch with hooks, and cleaned; it will then be readily traced to give off digital branches to three and a half toes, like the median in the hand. Careful dissection will display twigs from these digital branches to the flexor brevis pollicis, and two inner lumbricales. These muscles will be seen at this stage, but must be dissected later on.

The external plantar artery and nerve must be carefully traced across the foot to the base of the metatarsal bone of the little toe, where they both are seen to divide into a superficial and a deep branch. The superficial branch of the nerve can be easily seen to form digital branches for the remaining toes, whilst the deep branch and the plantar arch must be left till more muscles are removed.

The superficial branch of the external plantar artery is not usually so named, but is spoken of as the digital branch to the little toe; but it is, as the student who dissects it will see, more superficial than the remaining digital branches which will be displayed later on.

The long flexor tendons that descend from the back of the leg will be seen to form the next layer which is presented to view. They must be well in view by this time, and will be clearly indicated if the corresponding muscles in the leg be pulled upon.

They must be well cleaned; when this is done there will be seen passing backwards from the long flexor of the toes, towards the heel, a short muscle, the flexor accessorius, which underlies the external

plantar artery. This muscle should be cleaned, and traced back to its origin on either side of the calcaneum. It is often flabby, and easily broken across.

The long flexor tendons must be cleaned and traced to their insertions, the tendon of the flexor brevis being cut away from one toe to show the relations of the two flexors. This generally involves a good deal of trouble, as the tips of the toes are often dry and hard by this stage of the dissection. The lumbricales which are attached to the deep flexor tendons may be cleaned at the same time.

A little more of the external plantar artery and nerve will be displayed when the tendons are pulled aside, but they are to be left alone a little longer.

It is quite possible, by cutting away the flexor accessorius, and by pulling the long tendons to one side or the other with hooks, to display the deep structures without actually dividing the tendons. But if the student finds any difficulty in doing this, he can divide the long tendons close to the annular ligament, and then he will easily get at the following muscles.

If he then pulls upon the peroneus longus, he will see how it runs under the foot to make its insertion into the great toe. Just along the superficial surface of this tendon three small muscles will be seen arising, all more or less taking origin from the sheath of the tendon. In a good foot not the slightest difficulty is experienced in seeing them; no foot is better than that of a negro, who is accustomed to run about barefoot.

On the side of the great toe is seen the flexor brevis pollicis with two insertions, like the corresponding muscle in the hand; external to this the adductor pollicis; and running up the outer side of the little toe, the flexor brevis minimi digiti. The latter is only a single muscle, and has not two heads like the pollicis. It is often mistaken by the student for one

of the plantar interossei, which lie between it and the adductor pollicis.

At the distal ends of the metacarpal bones some transverse muscular fibres (the transversalis pedis), often very ill-developed, are seen.

All these muscles must be cleaned as well as they can be, and learnt.

If the adductor pollicis be cut away from its origin, there will be seen underneath it the deep branch of the external plantar nerve and artery, with its digital branches. The main artery runs inwards across the foot to the outer side of the great toe, to form the plantar (arterial) arch, and should be clearly seen to join with the dorsalis pedis, between the two heads of the first dorsal interosseous muscle.

If possible the nerve branches should be traced to all the neighbouring muscles.

Underlying the plantar arch are the interossei. They are usually so flabby that it is often a matter of great difficulty to dissect them. The student should refer to a descriptive anatomy for an account of them, and must clear away all the structures of one of the middle toes in order to make out their exact insertion into the extensor tendons and phalanges. If he clear everything else away, he will be able to make out the insertion of both dorsal and plantar interossei at the same time. It is better to choose the third or fourth toes for the purpose.

If the student turns his attention once more to the peroneus longus tendon, he will see its sheath carried back to the under surface of the os calcis as a white glistening structure, the long plantar ligament.

This ligament, together with the insertion of the tibialis posticus and the deep part of the foot, will be considered when the arches of the foot and the structures that support them are dissected.

During the dissection of the leg, which has just been described, it has probably been removed from the trunk, to suit the convenience of the dissector of the abdomen (*vide* page 175), so that it can now be turned over in any direction or position by the student who is working at it.

Before proceeding to examine the joints and ligaments, it will be better thoroughly to master the soft parts which have been dissected, as they will shortly need to be cut away.

Points to which attention may now be easily directed are the various anastomoses of arteries round joints, which, though alluded to before, have not been thoroughly dissected out. The annular ligaments, too, which bind down the tendons round the ankle-joint, must be carefully examined, and the sheaths themselves laid open by pushing a knife on scissors through them, from above downwards. In this way the student will easily see for himself which tendons occupy separate sheaths, and which do not. In examining those sheaths over the front of the ankle, the student should be very careful not to injure the anterior tibial nerve. It requires to be dissected very carefully if the nerve to the ankle-joint is to be found.

The nerves of the joints of the foot are not likely to be seen in a dissecting-room body.

DISSECTION OF LIGAMENTS OF LEG.

The **hip**.—The iliacus, psoas, and pectineus must be cleared away from the front of the hip-joint. Underneath the psoas a bursa is often seen, the extent of which must be determined by passing into it the handle of the knife, and exploring its size. Care should be taken to make out whether it communicates with the hip-joint; it does so sometimes by a small aperture.

The glutei must be cleared away from behind, and the obturator internus from the inside of the pelvis. The capsule itself must be cleaned, care being taken to look for a small branch from the obturator nerve, which underlies the obturator externus muscle. If the joint is at all stiff it should be soaked in water for several hours, or longer, according to its condition.

To demonstrate its movements the innominate bone must be held tight on the table and then rotated in all directions; this shows that its principal movement is rotation, and therefore that it is capable of motion in every direction; but it is concerned, as will be seen later on, in maintaining the body in the erect position.

To demonstrate this, the knee should be bent, and the leg placed on a table or the floor, in a kneeling position. If the thigh be grasped in one hand, and the innominate bone seized by the crest with the other, the student will find that he cannot rotate the innominate bone backwards farther than a certain point. This is owing to the front part of the capsule becoming tight, and also owing to the state of tension of the ligamentum teres (Fig. 8), which the student has not yet seen. To verify this, the acetabulum must be cut into from the inside, so as to display the working of all the ligaments at once.

This is best done with a trephine, but can be accomplished with a chisel and hammer. The point at which the bone should be perforated is as follows: Take a line from the centre of the anterior inferior spine of the ilium to the tip of the spine of the ischium, and make a hole in this line, beginning about half to three-quarters of an inch below the brim of the true pelvis. This will open the acetabulum without materially injuring the ligamentum teres. If the student repeat the experiments above mentioned, he can verify what has just been described.

The part of the capsular ligament which is made

tense during the experiment is sometimes called the ilio-femoral (Fig. 8), just as the other parts have received the name ischio-femoral and pubo-femoral. The

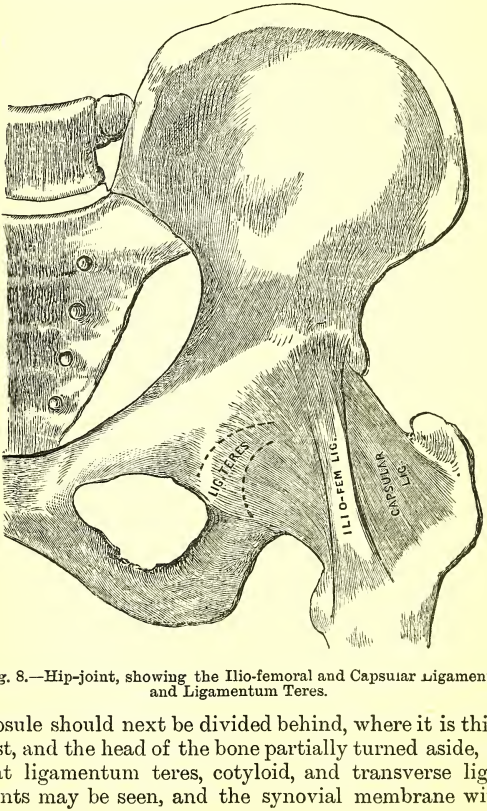


Fig. 8.—Hip-joint, showing the Ilio-femoral and Capsular Ligaments and Ligamentum Teres.

capsule should next be divided behind, where it is thinnest, and the head of the bone partially turned aside, so that ligamentum teres, cotyloid, and transverse ligaments may be seen, and the synovial membrane with

the so-called gland of Havers, which is only a pad of fat. The nerves from the obturator, accessory obturator, and sciatic, or sacral plexus, if they have before been seen, should be traced onwards as far as possible.

The **knee-joint.**—The movements of this joint are more easy to understand. It is best, as a preliminary measure, to divide the muscles on the front of the thigh about two inches above the knee-joint. Underneath the crureus some muscular fibres (subcrureus) can sometimes be seen, passing down to be inserted into the capsule of the joint. The semi-membranosus should be cut short about an inch and a half from its insertion; and the rest of the muscles, except the popliteus, which will be seen to perforate the capsule, must be removed.

The capsule of the joint will be so clearly seen under the crureus that there can be no difficulty in finding it. It should be then cut open, and turned downwards with the patella; this will expose the synovial membrane, the extent of which beneath the muscle should be carefully noted. Its size and extent must be examined by pushing the handle of the knife into it where the joint has been opened. Below, a line drawn round the leg at the level of the upper edge of the tibia, would indicate its lowest limits; at the back of the joint, a line drawn parallel to the last, about an inch above it, shows how high it extends; in front, the capsule and synovial membrane extend two fingers'-breadth above the patella. The uppermost of the posterior lines should be continued round the limb at this level, care being taken to carry the line higher up on the inner than on the outer side.

Three synovial folds, the so-called ligamentum mucosum and ligamenta alaria, should be examined. The former almost divides the knee-joint into two cavities, whilst the latter stretch from it along either side of the patella.

To display clearly the crucial ligaments and study their attachments the ligamenta mucosum and alaria should be removed.

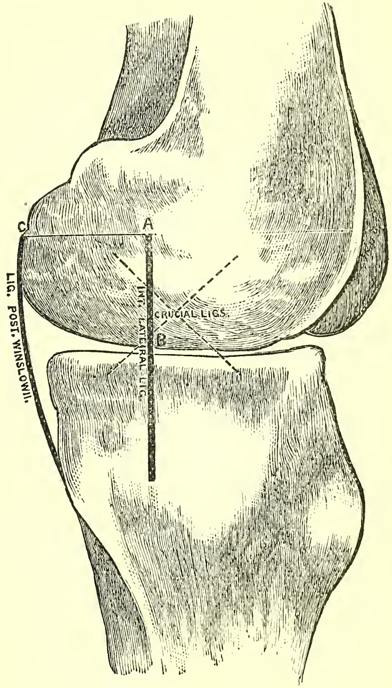


Fig. 9.—Diagram showing the Positions and Actions of the Lateral Crucial and Posterior Ligaments of the Knee-joint.

Enough has now been seen inside the joint to study its range and character of movement.

It is scarcely necessary to remind the student of

that which he can observe so well on his own body, that the knee-joint is capable of flexion and extension, and, to a limited extent, of rotation.

All this he can demonstrate on the leg before him, by holding the femur firmly, and swinging the tibia and fibula. He will find out another fact by endeavouring to rotate the tibia and fibula on the femur, viz., that he can do it only when the knee is bent. This will be readily demonstrated on his own body.

Again, though he can flex the leg upon the thigh, he cannot extend it beyond the points at which the femur and tibia are in the same straight line. When the leg is fully extended the posterior ligament, lateral ligaments, and crucial ligaments, will be found to be all tight, hence, it is they which prevent rotation in this position.

The action of the lateral ligaments is best shown in Fig. 9, from which it will be seen that the more extended the leg is, the more the lateral ligament is on the stretch ; this is owing to the fact that the distance A B is greater than the distance A C.

The articulations of the tibia and fibula above and below are almost fixed, and need but little dissection to display the ligaments in front and behind them.

The **ankle-joint.**—Having removed all structures from the ankle-joint and foot, except the tendons of the tibialis posticus, peroneus longus, and brevis, the ankle may be studied. The joints of the foot must be made as supple as possible by soaking them in water.

The external and internal lateral ligaments must be carefully cleaned. There will be no difficulty in finding them, starting at the tips of the malleoli, and stretching backwards, forwards, and downwards. The student should take care to trace the three fasciculi of the external lateral ligament.

By fixing the tibia the foot will be readily moved backwards and forwards, flexed and extended.

Other movements are apparently, though not really, performed by the ankle-joint; and to understand these the foot must first be studied, as it is by combining the motions of the foot and ankle that the movement, which at first sight appears to belong entirely to the ankle, is produced.

Movement takes place in the foot principally between the first and second rows of tarsal bones, and between the astragalus and os calcis.

The rest of the joints of the tarsus are comparatively fixed, and it is not until the phalanges are arrived at that much movement is again obtained.

That movement does take place at the joints just stated can be easily proved by taking the foot in one's hands, as will be explained directly.

The ligaments which limit this movement require now to be dissected. They are the long and short calcaneo-cuboid, and the inferior calcaneo-scaphoid. The long calcaneo-cuboid (long plantar) has been already displayed, and only requires to be traced on to the bases of the three middle metatarsal bones. Just on its inner side, stretching from the front of the os calcis to the adjoining surface of the cuboid, is the short plantar, and from the calcaneum to the scaphoid the inferior calcaneo-scaphoid. The latter should be well observed, as on it rests the head of the astragalus. (*Vide* Fig. 12, page 108.)

There are ligaments of less importance and easy to find, connecting the first and second rows of tarsal bones on the dorsum, which should be dissected.

The tibialis porticus will need to have its insertion very carefully dissected out, as it may be said to fulfil the function of a ligament, so closely is it inserted into the ligaments and bones of the foot. If it be put upon the stretch, its insertion can be easily seen.

In order to examine the great interosseous ligament which connects the os calcis and astragalus, and which is attached to the large grooves on their adjacent surfaces, these two bones must be separated, or a section made through the astragalus and os calcis. This cannot be done till the last thing, or it will spoil the movements, which must now be demonstrated.

By grasping in one hand one end of the foot, and the other in the other end, the joint between the first and second rows of the tarsal bones will be seen to be more or less of a ball-and-socket joint, whilst if the astragalus and os calcis be moved, especially when the tibia and fibula are removed, they will be seen to glide over each other.

If the student will try to perform a rotatory movement at the ankle-joint, both on his own foot and also on the part before him, he will soon become conscious that in this movement all the joints just described have a share.

The **maintenance of the body in the erect position,** and the **arches of the foot.**—It seems most appropriate to introduce this question at the end of the dissection of the leg.

If the student will refer to the Fig. on page 106, he may see, by aid of the following description, how comparatively little muscular action has to do with maintaining the body in the erect position.

The power which belongs to man of maintaining his body in the erect position with comparatively little fatigue is carried to a further extent in some animals; for example, the horse can go to sleep standing, and so can many birds whilst balanced only on one leg.

If the experiment is made, it will be found impossible to support a corpse without the aid of extraneous assistance; so that it is evident that something more is required than mere ligaments.

If the student will bear in mind the result of his

experiment in the case of the hip, he will remember that he was able to lock the joint in position when the crest of the ilium was pulled back, owing to the tension that was exerted on the ilio femoral and ligamentum teres, and that the knee could be locked by ligaments situated principally behind, and not in front, like those of the hip. The crucial, lateral, and posterior ligaments bring about this result.

Fig. 10.

If the student's part be placed with its foot on the ground, and the knee be fully extended, and pressure be made on the back of the iliac crest, he will find that there is no tendency for the knee or hip-joints to give at all; in other words, they remain automatically fixed. The ankle-joint cannot be fixed automatically, and so the leg will not stand of itself.

To demonstrate all these facts requires a little care and patience; but any one who has tried it several times will find no difficulty in doing so.

The ligaments which produce this result are marked diagrammatically as black lines in Fig. 10.

The weight of the body resting on the arches of the foot throws all these parts into a state of tension, and thus very little muscular power is called into play, even in the case of the foot.

The body can be very nearly balanced on the legs, and therefore, though the muscles up and down the front and back of the spine are in action whilst we stand up, they are not by any means in a state of powerful contraction.

A corpse propped against a wall requires but a mere touch of the finger to keep it upright, if care be

taken to put the knees and hips in the position above alluded to.

Many of the above facts can be demonstrated on the student's own body. If he will stand quite erect in an easy position, and then touch his thighs, he will find that the extensors and flexors are quite lax, but if he bend the least bit backwards or forwards they directly become tense and contracted.

The same fact can be demonstrated, though less easily, of the back and abdominal muscles, and if the student examine a friend's leg, he will find that the muscles on the front and back of the tibia are scarcely at all contracted when he is standing quite erect.

The **arches of the foot.**—A well-formed foot is clearly seen to possess a longitudinal and a transverse arch. These are represented in Figs. 11 and 12.

The transverse arch may be said to occur either across the distal row of tarsal bones, or across the bases

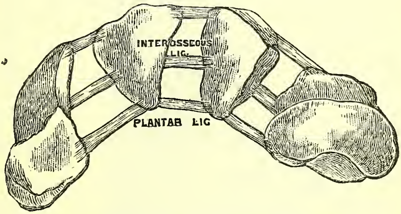


Fig. 11.—Transverse Arch of the Foot showing Dorsal, Plantar, and Interosseous Ligaments.

of the metatarsals, but it is best exhibited in the former situation, as in Fig. 11.

These bones, as will be seen in the Figure, can be readily examined by dividing the foot across between the first and second row of tarsal bones on the student's part. The ligaments will then be seen on the upper and lower surfaces of the bones, and the

interosseous ligaments may be seen between them.

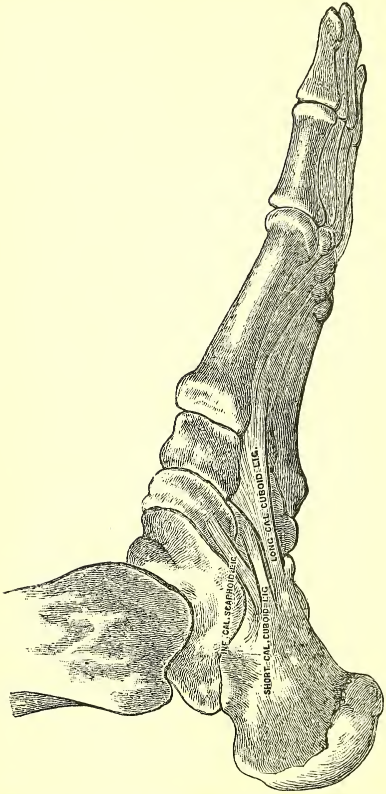


Fig. 12.—Longitudinal Arch of the Foot, showing Long and Short Plantar and Calcaneo-scaphoid (or Spring) Ligaments.

All these serve to keep up the transverse arch, and so also does tension exerted on the the tibialis porticus

and peroneus longus at the same time, as can be readily proved, as these tendons have been specially preserved.

The longitudinal arch (Fig. 12) is often for purposes of description divided into two, an outer and an inner arch, though it is difficult to see what is to be gained by such a method. As it is usually done, it will be followed here.

The outer arch is said to be formed by the calcaneum, cuboid, and the two outer metatarsals, and the inner arch by the rest of the bones.

It is mainly kept up by those ligaments, long and short plantar and inferior calcaneo-scaphoid, which have already been carefully dissected. If the inferior calcaneo-scaphoid (sometimes called the spring ligament, because it is said to contain elastic tissue) gives way, the head of the astragalus falls down on to the sole of the foot, and flat foot is the result.

The tibialis posticus and peroneus longus can be shown, by pulling on them, to have an important influence in maintaining the longitudinal arch.

This, it is very obvious, will be also very materially aided by all the structures on the sole of the foot, which form a series of tie bars from the os calcis to the toes.

When the arches of the foot have been thoroughly studied, the bones should be disarticulated, the great interosseous and other ligaments of the foot examined.

CHAPTER V.

DISSECTION OF THE ABDOMEN.

In most dissecting-rooms, the abdomen includes that portion of the body situated between the lower part of the ribs and the upper part of the pelvic bones.

Added to this is the perinæum. The deeper muscles of the back are usually included with the head and neck.

Surface Markings.

Tip of sternum.	Crest of pubes.
Edges of ribs.	Poupart's ligament.
Crest of ilium.	Linea alba.
Anterior superior spine of ilium.	External abdominal ring.
Symphysis pubis.	Position of navel.
Spine of pubes.	

Before any dissection is started, the principal surface-markings must be mastered. The body is supposed to be lying on its back, with a block or two placed in the hollow of the back, so as to make the abdomen prominent in front.

The student must feel with his fingers the edges of the ribs, and the tip of the sternum. At the lower part of the abdomen, the crest of the ilium should be felt, terminating in front in the anterior superior spine of the ilium, which is usually very plain, even in the very fattest bodies, and forms a well-marked prominence on the outer side of the upper end of the thigh.

In the middle line, just above the penis or vagina as the case may be, the symphysis pubis can be easily made out, and if the body is not too fat, about $\frac{3}{4}$ inch outside this the spine of the pubes (Fig. 14). The space between these two points is called the crest.

It is very important to bear in mind the exact position of the crest, spine, and symphysis.

Running up the middle line of the body, from the symphysis to the sternum, is a line generally well marked on the skin, the linea alba; and from the symphysis outwards to the anterior superior spine is a well-marked depression, which indicates the line of Poupart's ligament.

If the student lay hold of the lower part of the scrotum, and invert it from below towards the crest of the pubes with his little finger, he will feel his finger

enter a small aperture with hard edges, which is situated over the crest of the pubes. This is the external abdominal ring.

He should next pass a piece of string round the abdomen at the level of the navel; it will be found to

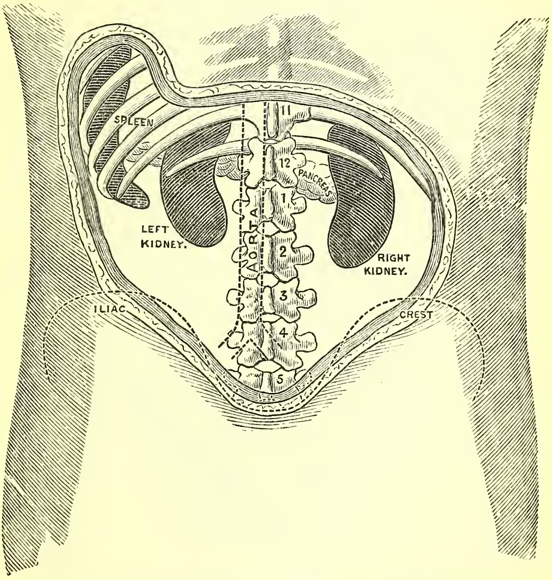


Fig. 13.—Showing the Relations of the Kidneys, etc., to the Ribs, and Crests of the Ilium from behind.

touch the highest point of the crest of the ilium, thus demonstrating that these two landmarks are situated at the same level.

As the abdominal walls are usually very flaccid, it is better to distend them before commencing to dissect.

Take a blow-pipe, and after cutting a small hole in the navel, pass it into the cavity of the abdomen; secure it with a bit of string, and blow up the walls until

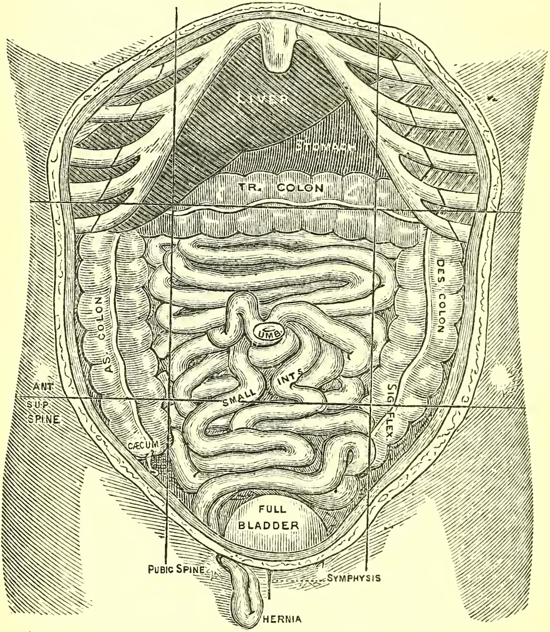


Fig. 14.—Showing the Positions of some of the most important Abdominal Contents.

they are as tight as they can be made. (In some dissecting-rooms a pair of bellows is kept for the purpose). Remove the blow-pipe, taking care to tie up the hole tightly. When this has been done, the following skin incisions should be made.

One from the lower end of the sternum to the symphysis pubes (*a*); a second at right angles to this at its upper end (*b*); and a third at right angles to it at the level of the navel (*c*). Both of these incisions must be carried as far out as the position of the body will allow. Dissect off the flap of skin which they include, and carry it outwards as far as is possible, taking care to remove nothing else but the skin.

The lower flap must be turned downwards and outwards, commencing the dissection from the two incisions which have been already made.

Unless the body is very thin and emaciated, there will be a considerable amount of fat.

The Cutaneous Vessels and Nerves.

Lateral cutaneous nerves and arteries. Anterior cutaneous nerves and arteries. Upper, from intercostal nerves.	Lower, including ilio-hypogastric and ilio-inguinal, from lumbar nerves. Ilio-hypogastric and ilio-inguinal of special importance.

Buried in this fat lie the cutaneous vessels and nerves. As is the case with the intercostals, there is one corresponding to each vertebra. They become superficial mainly along two lines, one situated an inch or two outside the middle line of the body, and the other quite at the side. (*Vide* Fig. 15.)

In order to find the central branches, the student should scrape carefully with a scalpel in the fat until he finds some minute arteries, which, if injected, will not be difficult to discover. The cutaneous arteries and veins at the upper part of the abdomen will be branches of the intercostals, and those below from the superficial epigastric, and perhaps from the lumbar. Accompanying them the nerves *may* be found, though it is by no means easy to find them in ordinary bodies, and if the arteries are not injected, almost impossible. They vary much in number and distribution.

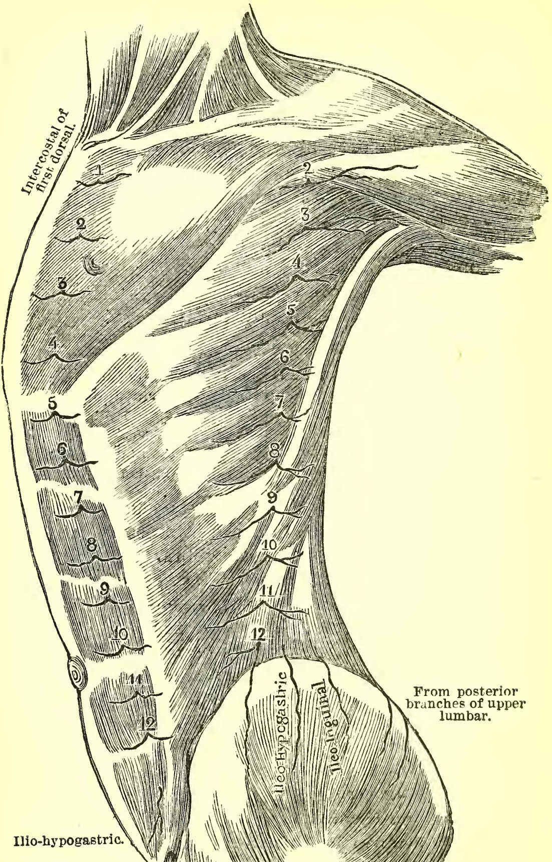


Fig. 15.—Cutaneous Nerve-supply of the Trunk and Gluteal Region.

The two lower branches which emerge in this line are perhaps the largest, and for that reason easier to find. The upper or hypogastric branch of the ilio-hypogastric emerges about two inches above the external abdominal ring and the inguinal branch of the ilio-inguinal at the external abdominal ring, immediately over the crest of the pubes. It then passes downwards to supply the penis and scrotum in the male, and the labia in the female.

The lateral branches will be found emerging in the mid-axillary line (a perpendicular line drawn from the centre of the armpit downwards, when the body is erect). They are rather larger than the anterior branches, but it is the lower one or two which are most readily found, viz., the descending branch of the last dorsal and the iliac branch of the ilio-hypogastric. The former of these passes over the crest of the ilium, slightly in front of the mid-axillary line.

No very definite rules can be laid down for finding them, and it is only by diligent and careful scraping in the direction in which they run, and by taking care to remove the fat in a series of thin layers, as if it consisted of a number of superimposed sheets of paper, that they can be found with any approach to certainty.

Removal of fat.—The fat will now require to be removed wherever it still remains after the search for cutaneous nerves is completed. Remove it by the same incisions as were employed in the case of the skin; the tissue in which it lies forms a continuous layer all over the body, immediately underlying the skin. It is sometimes called the superficial fascia; in reality it is a subcutaneous network, which, if distended with fat, is of considerable thickness; or may, in emaciated subjects, consist of nothing but a thin layer, resembling in appearance the deep fascia, which will next be seen.

Along with the fat some lymphatic glands will be removed, in the neighbourhood of the groin.

The **deep fascia.**—When the fat is all removed, a more or less glistening membrane (deep fascia) will come into view, through which the subjacent muscles will be readily visible. Here there will be seen some minute holes in this fascia, through which may be seen emerging the minute nerves and arteries that have before been found; and other holes, proclaiming by their emptiness the positions of nerves and vessels that have been cut away.

The **external abdominal ring.**—Just over the crest of the pubes a hole will be seen, oblique in direction, as large perhaps as an almond, and bounded on either side by two strong bands of fascia. This is the external abdominal ring, and the two bands of aponeurosis bounding it are called the external and internal pillars of the ring (Fig. 17, page 121). It gives passage to the spermatic cord in the male subject, and in the female, in which it is usually smaller, to the round ligament. This ring must be very carefully dissected, and the inguinal branch of the ilio-inguinal nerve, which has been before alluded to as emerging from it, should be traced onwards to its ultimate destination in the external generative appendages. The student must not forget that all the nerves which have been found so far come round from the spine, and will have to be traced farther back, to their origin, at a later stage of the dissection.

The muscles which form the wall of the abdomen are as follows:

External oblique.	Transversalis.
Internal oblique.	Rectus and pyramidalis.

It will now be readily seen that the fibres of the most superficial muscle (external oblique) run downwards and inwards.

Make an incision through the deep fascia and the external oblique muscle from the umbilicus to the crest of the ilium. Leave the portion of muscle below this line, and clean the upper part, taking care to begin at the free back edge of the muscle, which abuts upon the latissimus dorsi, and which is situated about the junction of the middle with posterior third of the crest of the ilium.

Reflect the deep fascia from the external oblique by cutting very carefully parallel to the course of its fibres. This is by no means an easy muscle to clean, more especially when the thin tendinous portion towards the front of the abdomen is reached. As soon as the fascia is dissected up as far as the middle line of the body in front (linea alba), cut it away altogether.

In the course of cleaning the muscle from behind forwards, its three digitations on the ribs with the latissimus dorsi will come into view; higher up, those with the serratus magnus; and next to this again, the edge of the pectoralis major.

The external oblique must now be turned forwards to display the structures which lie beneath it. It has been already cut through below; make another incision along the edge of the ribs, and turn it forward from its back edge towards the linea alba.

The lower portion of the muscle, more or less triangular in shape, which has been left with its fascia undissected, can be turned downwards towards the groin, like its corresponding portions of fat and skin, and left for the present for further consideration in connection with the anatomy of hernia.

Passing up from the inner end of Poupart's ligament towards the linea alba, and situated behind the internal pillar of the ring, a few fibres may be seen in some bodies. From their triangular shape, these have received the name of the triangular ligament.

What is seen underneath the external oblique.—Underneath the external oblique will be seen the internal oblique, whose fibres run at right angles to those of the muscle, just as the fibres of the internal intercostals decussate with those of the external.

Besides this, some nerves and vessels entering the external oblique will have been cut through, and some of the cutaneous nerves which have been already seen can be traced a little farther towards their origin, as they traverse the abdominal muscles obliquely. There is also the triangular ligament, which has just been described.

The internal oblique having been cleaned, it now only remains to cut through it by exactly similar incisions, and turn it forward. On its under surface, separating it from the transversalis, is a small artery, which runs from the anterior superior spine towards the navel. It is a branch of the deep circumflex iliac, which will be exposed and dissected later on, and which also forms a guide to the line of separation between the two muscles.

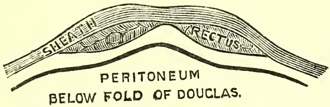
On reflecting the internal oblique, the transversalis is exposed. It is readily recognised by the transverse direction of its fibres. It must be cut through and reflected, precisely in the same manner as the preceding muscles.

During the process of turning each of these muscles forward, a still further portion of the cutaneous nerves will be exposed, and they will be easily traced back some distance farther towards their starting place.

Dissect them carefully, and see that they supply these muscles as they pass through them.

Some small vessels will also be seen accompanying these branches of the intercostal and lumbar arteries, and perhaps some also form the deep epigastric, which will be more fully exposed by and by.

Whilst engaged in endeavouring to turn the internal oblique and transversalis inwards, the student will come upon the rectus, which runs up the front of the abdomen from the pelvis to the chest. He can either stop short at its outer edge, or carry his incision as far as the middle line as before directed, and in so



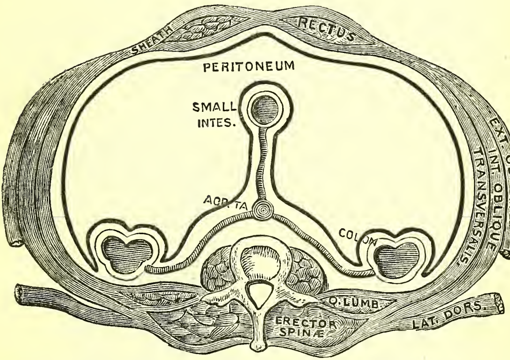


Fig. 16.—Diagram of a Transverse Section of the Abdomen just above the Level of the Crest of the Ilium.

doing cut the rectus across. If he select the latter course, the rectus must be first divested of its sheath, and its origin and insertion must be made out.

The relationship of the sheaths of the internal oblique and transversalis to the rectus *must be carefully mastered* after dissection. It will be easily understood by reference to Fig. 16.

At the outer edge of the rectus muscle the aponeurosis of the transversalis and internal oblique become blended; these two muscles may, in fact, be said to be inserted into an aponeurosis, which begins at the outer margin of the rectus. In the upper part of the abdomen this aponeurosis splits into two to enclose the rectus; but the lower part of this muscle, usually about the lower third, has no aponeurotic sheath on its deep surface, because the whole of the aponeurosis of the internal oblique and transversalis passes in front of it. There is usually a clearly marked lower edge to the posterior sheath of the rectus, called the fold of Douglas.

Sometimes it requires a little dissection to make this edge plain. Between this point and the pelvis, the fascia transversalis is in relation with the back of the rectus.

Inguinal Hernia (coverings).

Direct:	*Indirect:*
Does not pass down the inguinal canal, and is inside the epigastric artery.	Passes down the inguinal canal, and is outside the epigastric artery.
Peritoneum.	Peritoneum.
Subperitoneal fat.	Subperitoneal fat.
Fascia transversalis.	Fascia transversalis.
Conjoined tendon.	Infundibuliform fascia.
Intercolumnar fascia.	Cremasteric muscle and fascia.
Deep fascia.	Intercolumnar fascia.
Superficial fascia.	Deep fascia.
Skin.	Superficial fascia
	Skin.

N.B.—The coverings of the scrotum in the natural state are precisely the same as those of an indirect inguinal hernia.

In the female, similar layers can be traced, though not easily, into the labia majora, which correspond with the scrotum of the male.

There now remains still undissected the portion of the muscles in the neighbourhood of the innominate

bone. This part has been left so far, because it is of the greatest importance in connection with the anatomy of inguinal hernia. It is commonly imagined by

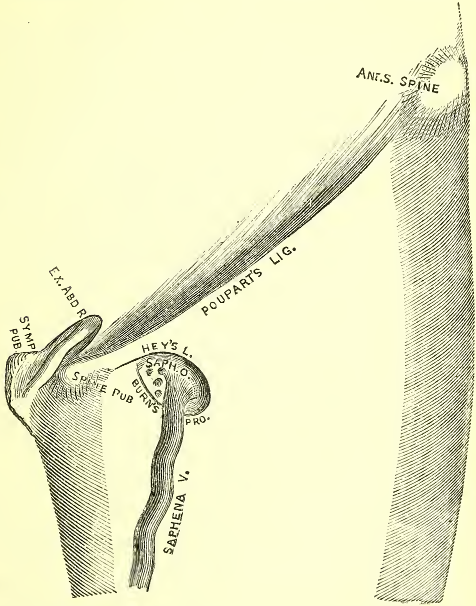


Fig. 17.—Showing Position and Boundaries of Saphenous Opening and External Abdominal Ring.

the student that this region is sacred, and must only be touched by the demonstrator. With a little care, and by the aid of the knowledge of the various abdominal muscles which the student has already gained, he can quite easily dissect it for himself.

The layer of subcutaneous tissue, together with the external oblique, have already been turned down over the region of the groin; the internal oblique and transversalis must follow suit, and be turned over in the same direction.

Before doing so, however, the student should examine once more the position of the external abdominal and the femoral ring. He will easily see that the femoral ring is below, and to the outer side of the spine of the pubes, whilst the external abdominal ring is above and to the inner side of the spine. (*Vide* Fig. 17.) That the internal abdominal ring at the upper end of the inguinal canal lies midway between the spine of the pubes and the anterior superior of the ilium, he must at present take for granted; he can prove and verify this later on, when it is dissected.

Between the columns (pillars) of the external abdominal ring he will find some thin fasciæ, or at least the remains of some. This is called, from its situation, intercolumnar, and can be shown by a careful dissector to pass over the cord and envelop the scrotum, forming one of its coats, whilst it is continuous above with the margins of the ring.

When the external oblique has been turned down, making use of Poupart's ligament as a hinge, a piece more of the spermatic cord and the inguinal branch of the ilio-inguinal nerve will be exposed.

When the fibres of the internal oblique are cleaned, the spermatic cord will be seen to be crossed by the lower edge of the muscle, and some of the fibres can be traced down over the cord into the scrotum; and after this they pass up again behind the testicle to the symphysis pubis, forming another of its coverings.

These scattered fibres have received the name of the cremaster muscle, and the fascia that unites them

is called cremasteric. To trace the muscular fibres up to the pubes again, the scrotum must be lifted up; but the student must not be disappointed if he does not find them, as they are often very rudimentary. They are greatly increased in size when an old hydrocele or scrotal hernia is present.

The internal oblique must now be turned down like the external. The student will note that he is quite unable at the inner part (*i.e.*, nearest the symphysis pubis) to separate the internal oblique from the subjacent transversalis, because they are blended to form the conjoined tendon. The conjoined tendon is the lower end of the anterior sheath of the rectus, which is inserted into the crest of the pubes, and prolonged some distance outwards along the linea ilio-pectinea. The rectus, as has been already seen, has no posterior sheath in the lower third. Towards the crest of the ilium the internal oblique and transversalis are easily separated by a thin layer of fat or areolar tissue, which is rarely absent. But if any difficulty is experienced in separating them, the deep circumflex iliac artery, mentioned above, will serve as a guide.

The transversalis will be next turned down, taking care to dissect off from it, and to leave behind, the thin fascia which lies on its under side (the fascia transversalis), and which is continued, under the name of the infundibuliform fascia, over the cord down into the scrotum. It is so called from its funnel shape, which can be easily seen with care from the inside of the abdomen, but is not so easily recognised on the outside.

In order to demonstrate the fact that the infundibuliform fascia passes down to form one of the constituents of the scrotum, the cremaster muscle and fascia must first be removed.

The layers of the external oblique, internal oblique,

and transversalis, should be examined once more to see that they have been thoroughly divested of fascia and fat. This remark applies more particularly to the origin of the internal oblique and transversalis from the outer part of Poupart's ligament, which often remains undissected. Not less important are the insertions of the various muscles into the crest of the pubes. These insertions must be carefully dissected, or the anatomy of this region will not be understood.

The structures on the crest of the pubes lie in the following order, from without inwards :

Skin and fascia.	Conjoined tendon.
Exterior oblique.	Pyramidalis.
Triangular ligament (not always present).	Rectus.
	Fascia transversalis.

When the transversalis is turned down there will be clearly seen an artery (deep epigastric), which will almost certainly be injected, running from the middle of Poupart's ligament towards the region of the navel. On closer inspection it will be seen to lie between two thin membranes; the outer and upper is the fascia transversalis, and the lower the subperitoneal fat and peritoneum. These two layers are often so closely blended at every part excepting where the artery separates them, that it requires a skilled dissector to remove the one from the other in a continuous layer. Both of these structures must be turned down over the groin, like the muscles.

During the course of this dissection it will have become evident that the spermatic cord traverses the abdominal muscles obliquely, just as the nerves, arteries, and veins have been found to do higher up the belly wall. When the spermatic cord enters the abdominal cavity it is soon lost to view in the pelvis, and must be traced later on. The opening in the

transversalis fascia by which it enters the abdominal canal is called the internal abdominal ring, but it is not nearly so well marked as the external, and may be easily overlooked.

The opening in the abdominal muscles which the spermatic cord makes for itself is called the inguinal canal. It will be seen to be about an inch and a half in length, and to contain the spermatic cord, genito-crural, and ilio-inguinal nerves. The latter ought to have been found before this, and can be traced up to the transversalis muscle; the former enters the inguinal canal along with the spermatic vessels from the abdomen, and is often very difficult to find, as it is extremely variable in size. The dissection of the spermatic cord itself will be completed with that of the testicle. (*Vide* page 136.)

The transversalis fascia has already been mentioned as overlying the epigastric artery. The student should trace it all over the front of the abdomen, and note that on its under-surface is a layer of fat (sub-peritoneal), which is of considerable importance surgically, as it enables the surgeon to know when he is close upon the peritoneum.

If the epigastric artery be traced downwards it will be seen to come off from the external iliac, on its inner side usually; and just opposite to it on the outer side of the external iliac (sometimes arising as a common trunk with the epigastric) is another artery, the deep circumflex iliac.

It should be traced by pushing and dissecting the peritoneum, from its surface to the anterior superior spine of the ilium, where it pierces the transversalis and internal oblique in an oblique direction, and then runs between them; and if pursued still farther, its anastomosis with the last lumbar artery can be seen, if it is injected.

The peritoneum must be divided by similar

incisions to those which were employed in the case of the muscles, and the abdomen will be opened.

On the superficial surface of the peritoneum there will be seen the following structures, running in different directions from the umbilicus.

(1) A round cord, the remains of the umbilical vein going to the liver.

(2) Another cord (urachus, remains of the allantois) passing down to the top of the bladder.

(3, 4) A cord (the remains of the hypogastric arteries) on either side of the above, passing to the inguinal regions.

The **perinæum.**—The perinæum is that part of the body which lies between the anus and the symphysis pubis. It is bounded on either side by the rami of the pubes and ischium.

It includes, therefore, the external generative organs, and occupies the anterior part of the outlet of the pelvis, the back part containing the rectum and ischio-rectal fossæ.

Position for dissection.—The body should be placed in lithotomy position, *i.e.*, on its back with the buttocks drawn well to the edge of the table, the legs flexed upon the abdomen and well abducted. They must be secured in this position by a piece of rope passed under the hollow of the back and secured firmly to the two knees.

The student must have a pelvis before him at the same time, which must be placed so that the sacrum lies with its back surface on the table, and the symphysis as nearly as possible horizontal; he will then be able to appreciate the exact position of the bones in the body before him.

Surface Markings (Fig. 18).

Symphysis pubis.
Rami of pubes and ischium.
Tuberosity of ischium.
Position of triangular ligament.

It will be easy to feel the symphysis pubis just above the penis or vagina, as the case may be, and then to pass the finger down the rami of the pubes and ischium, till the ischial tuberosities, upon

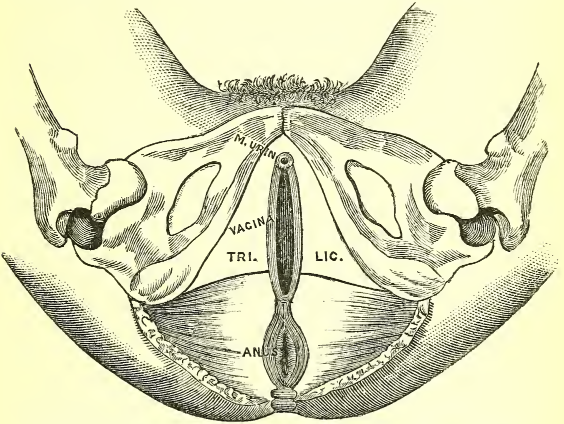


Fig. 18.—Showing the Position of the Triangular Ligament in the Male and Female.

which the body rests in the sitting posture, are reached. Midway between these two tuberosities lies the anus.

The student will next notice that there is a triangular space in the centre of the diagram, which is not shaded, and has a small hole near the top. This space indicates the exact situation of a structure that will be dissected later on (the triangular ligament), and the hole indicates the situation of the urethra, from half to three-quarters of an inch below the symphysis. The triangular ligament is attached to the *back* edge of the rami of the pubes and ischium. In order to

clearly grasp its exact situation and attachments it is best to paste a piece of paper on to the rami in the exact position of this ligament.

The dark shaded oval space in the centre represents the position of the vagina in the female. It will be clear, therefore, that as the vagina occupies so large a space between the rami of the pubes, the triangular ligament in the female must be only a rudimentary structure.

It only remains to bear in mind that the triangular ligament consists in reality of two layers, which, though touching one another everywhere at their circumference, are separated in the centre by a space of about half an inch. Both of these layers are perforated by the urethra and vagina.

The student must master these outlines, and carefully keep in mind their exact situation, as they may be said to form the framework of the perinæum.

MALE PERINÆUM.

List of Important Structures.

Cutaneous nerves:
- Inferior hæmorrhoidal.
- Superficial perineal.
- Long pudendal.

Cutaneous arteries:
- Inferior hæmorrhoidal.
- Superficial perineal.

Ischio-rectal fossæ, boundaries and contents.

Sphincter ani, deep and superficial.

Levator ani and coccygeus.

Deep layer of superficial fascia (exact attachment).

Underneath this fascia, between it and triangular ligaments—
- Erector penis.
- Accelerator urinæ.
- Transversus perinei.
- Bulb of urethra.
- Branches of pudic nerve, artery, and vein.

Triangular ligament.

Skin incisions.—After stuffing the rectum with tow, make an incision down the middle line of the perinæum from the back part of the scrotum to the tip of the coccyx, cutting carefully round the margin of the anus. Make two transverse incisions, one at

the back of the scrotum, and a second just in front of the anus.

Take care to turn back nothing more than the skin, otherwise the superficial sphincter ani will be cut away. There is usually a considerable amount of fat in this region underlying the skin. The skin flaps must be reflected farther outwards than the margins of the bony outlet of the pelvis, so as to expose just the origin of the thigh muscles.

If the student scrapes carefully round the margin of the anus when the skin is removed, he will, if the body be sufficiently fresh, find the fibres of the superficial sphincter encircling it.

The deep sphincter is only the thickened lower end of the intrinsic muscular fibres of the rectum, and must be exposed by stretching or slitting open the lower end of the bowel, and removing the mucous membrane, when it will be clearly seen. A white line is said to separate the external from the internal sphincter (Hilton).

An inch or less from the margin of the anus, radiating towards it, are some small arteries and veins, and accompanying them some nerves, which are going to supply the skin of this region; they can be traced outwards by incisions radiating from the anus towards the ischial tuberosity, where they spring from the pudic artery, vein, and nerve respectively. The perinæum receives almost the whole of its blood and nerve supply from the pudic vessels and nerves.

When the student has dissected the external sphincter as far back as the tip of the coccyx, he will have no difficulty in discovering the edge of the gluteus maximus, and along its edge, which stretches from this point to the ischial tuberosity, he will discover some small twigs of the lesser sciatic nerve.

If the dissection be continued round the edge of the gluteus maximus on to its deep surface, it will soon be evident that on either side of the rectum there is a deep fossa filled mainly with fat (ischio-rectal fossa).

If the student proceed carefully to remove this fat from the side of the rectum, keeping at the same time close to the sphincter, he will come upon a muscle which is inserted round the lower part of the rectum. It comes from the sides of the pelvis. This muscle is called the levator ani.

If its fibres are followed to the tip of the coccyx, about three-quarters of an inch from the anus, a very slight cellular interval will be found separating it from the coccygeus. The lower fibres of the coccygeus, where it abuts upon the levator ani, may be recognised by their direction, which courses from the ischial spine to the tip of the coccyx.

Emerging through the cellular interval between the levator ani and coccygeus is a branch of the fourth sacral nerve, which descends to supply the external sphincter and the integument, and which serves as a guide to the line of separation between the two muscles.

By carefully scraping on the outer surface of the coccygeus muscle, the student will find the branch of the fifth sacral nerve, which pierces it close to the junction of the sacrum and coccyx. Perhaps also he may find the coccygeal nerve, sometimes called the sixth sacral, which emerges from the great sacrosciatic ligament, which it pierces, and joins with the fourth and fifth to form the coccygeal plexus. However, the nerves forming this plexus are very small, and can only be made out by experienced dissectors.

In order fully to display them, the fibres of the gluteus maximus may be divided for about an inch close to the side of the coccyx.

If the student now turns his attention to the neighbourhood of the ascending ramus of the ischium, he will find close alongside it some nerves called the superficial perineal, and arteries of the same name which accompany them. As the nerves pierce the deep layer of the superficial fascia, they will be more fully seen when the time comes for its removal.

With the exception of the nerves that have just been described, the ischio-rectal fossa contains nothing else but fat, which must now be carefully and cleanly dissected out from the muscles to which it is attached.

When this cavity is exposed it will be seen to be, roughly speaking, conical in shape. On its inner side is situated the levator ani, covered by the very thin anal fascia; and on its outer, the wall of the pelvic cavity, which is, to a considerable extent, covered by the obturator internus, and the strong obturator fascia.

If the finger is passed up from the tuberosity along the inner wall of the pelvis, the pudic vessels (if injected) will be felt about three-fourths of an inch up. The student will also notice, when both ischio-rectal fossæ are cleaned out, that there is no communication between the two, owing to the median fibrous septum which divides them.

This fibrous tissue, where it joins the anus to the coccyx, is called the ano-coccygeal ligament, and, in front of the rectum, the central tendon of the perinæum. Emerging from under the edge of the gluteus maximus, about an inch outside the ischial tuberosity, will be found the long pudendal branch of the lesser sciatic; it can be traced forwards as far as the scrotum.

When the fat in which this nerve lies has been removed, another layer of fascia will be exposed, which is seen to be attached on each side to the ramus of the pubes and ischium, and to turn downwards behind to

form the front boundary of the ischio-rectal fossa. It there becomes continuous with what has been already described, but not yet seen, the triangular ligament. In front it can be traced up to become continuous with the fascia of the abdomen.

It is very easy, if great care be not taken, to remove this layer of fascia along with the fat which lies upon it. To avoid doing so, the student should scrape with the handle of his scalpel at the border of the rami of the pubes, as by so doing he will run less chance of wounding the fascia.

When a portion of the surface of the fascia has been exposed by the method just described, a small hole should be made in it with the point of the knife, and the blow-pipe inserted. The blow-pipe must then be secured by a piece of string, and the fascia inflated with air. It is possible to distend the space under the fascia with water by means of a syringe; but neither of the above manœuvres is easy to accomplish, as the fascia is dense, and fits so tightly in its place that even when it is distended with urine, as it sometimes is in the case of extravasation, there is no very great bulging. This fascia is usually called the deep layer of the superficial fascia. Its connection with the fascia of the abdomen, with which it is continuous, can be traced either by dissection, or by one of the modes above described. The exact relationship of these fasciæ will be better understood by reference to Fig. 19.

When its arrangement has been thoroughly mastered, it can be cut down the middle line of the body and along its posterior edge, where it winds round the transversus perinæi muscle to be attached to the triangular ligament. The flaps can be turned aside over the rami of the pubes and ischium, like a pair of folding-doors. The following muscles will be exposed: In the centre, surrounding

the penis, is the accelerator urinæ. The student must take great care to trace out the anterior fibres which pass round to envelope the corpora cavernosa penis. On either side, passing up from the rami of

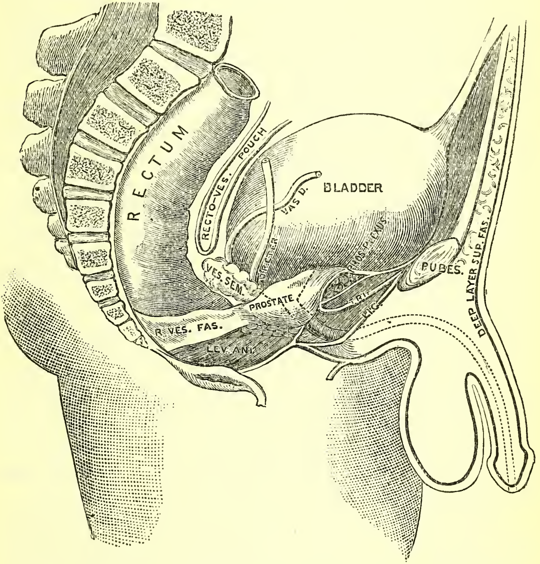


Fig. 19.—Side View of Triangular Ligament and Deep Layer of Superficial Perineal Fascia.

the pubes to the sides of the penis is the erector penis, and quite at the back of this fascia, where it dips down to join the triangular ligament, is the transversus perinæi. The latter muscle consists of two or three small muscular bands, and hence may be easily cut away. Sometimes it is described as

consisting of a deep and superficial portion, the deeper fasciculus being situated in between the layers of the triangular ligament.

By scraping along the fibres of the transversus perinæi muscle, there will be found an artery and nerve of the same name, which can be readily traced back to the pudic ; a bit more of the superficial perineal artery and nerves will be exposed, and several other smaller nerves and arteries.

The next thing to be done is to remove the accelerator urinæ, which completely covers and hides the bulb of the urethra, and likewise the erector penis, which covers and hides the crus penis.

The anterior layer of the triangular ligament, which was referred to before, will then be exposed. It is, on the whole, better not to attempt a deeper dissection of the perinæum at this stage, otherwise it is impossible to obtain a good side view of the pelvis, and to understand clearly the relations of the prostatic and the membranous portions of the urethra.

The continuity of the walls of the scrotum and abdomen has already* been made out in the dissection of that part. It now only remains, therefore, to remove the remnant of the scrotum, and so make out the structure of the penis. To effect this, the scrotum, with its skin and fascia, must be turned upwards.

The testicles, which can be easily felt lying in their sacs (the tunica vaginalis), should be cleared, with their sac unopened, from the surrounding skin and fascia, and cut away all remains of the structure along each side of the ascending ramus of the pubes, and the under side of the penis.

The two testicles, each in their own tunica vaginalis, will now be connected with the body by the spermatic

* If the scrotum has not been dissected, the student must turn to page 122, and dissect its various layers before attempting their removal.

cord only, and must be turned up out of the way on to the abdomen.

It will be quite evident that the penis consists of three portions, a central and two lateral. The centre one contains the urethra; to make this clear pass a catheter down from the orifice. If the student has no catheter at hand, he can employ the blow-pipe in his dissecting case, and if he compress the urethra as far back as he can, he will be able, with his blow-pipe, to distend the bulb with air, and so understand how it has acquired its name.

This portion of the penis is called the corpus spongiosum. The student should notice that it forms the expanded end of the penis, called the glans. The portion of the urethra just described is called *the penile portion.*

To understand the relationship of the two side pieces (corpora cavernosa penis), which are placed side by side, and attached behind, as is readily seen, to the rami of the pubes, the student must cut off the penis in front of the symphysis, and look at it in section, when he will readily understand the arrangement of the several parts.

Separating the two corpora cavernosa is the septum pectiniforme. To get a side view of this, one corpus cavernosum must be quite cut away, when the dense fibres of the septum, arranged more or less like a comb, will be brought clearly into view, especially if the parts be put upon the stretch.

DISSECTION OF THE TESTICLES AND CORD.

List of important Structures.

Tunica vaginalis (its extent).
Tunica albuginea.
Spermatic cord:
- Veins.
- Three arteries:
  - Spermatic
  - Artery of vas
  - Cremasteric.

Vas deferens.
Epididymis.
Tubuli seminiferi, and internal structure of testicle.

Before attempting to remove the testicles, the student should make a tiny cut into the sac (tunica vaginalis), in which the testicle lies quite loose and free, insert his blow-pipe and distend it, so as to make out exactly where it is attached to the testicle, and how far it extends up the cord.

The distance which it passes up the cord varies considerably, from about one quarter of an inch and upwards. It may, in some cases, be connected with the peritoneum in the adult, whilst in the fœtus this connection is always unmistakable. In addition to this, it will be readily seen, when the tunica vaginalis is distended, that there is no space between it and the testicle behind, and that the epididymis and vessels do not perforate but pass in behind it. A little dissection at this point will render it quite clear that the tunica vaginalis is reflected over the testicle, and belongs to that class of structures called serous sacs. This fact will be rendered still more clear when the tunica vaginalis is slit open. This can be done now or later on.

The cord must be severed close to the external ring, and the testicle can either be dissected at once or kept moist for future examination at leisure.

The testicle should be pinned out on a board or bit of cork, resting on its back surface; the tunica vaginalis slit in front, and reflected.

The testicle will then be seen, covered on its back and outer surface by another mass, the epididymis, and passing up behind it is the spermatic cord.

There is usually to be seen at the upper end of the epididymis in the fossa, between it and the body of the testis, an oval body about the size of a small apple-pip, which is called the hydatid of Morgagni; and on the cord itself, just above the testicle, some little excrescences, the organ of Giraldés, may be present.

Examine the spermatic cord, and see that the vas deferens (testicle duct) with its arteries is situated behind, whilst the veins are well in front; unless they are varicose they may be easily overlooked.

The student must take the cord between his finger and thumb, and see how easily the hard vas deferens is distinguishable, like a piece of whip-cord, from the veins in front. It is often very important to distinguish them on a living body. The vas should be traced down to the epididymis and divested of its sheath. The testicle itself must be sliced longitudinally, so as to show its internal structure.

It will be seen to be enveloped in a fibrous covering, the tunica albuginea, and to be crossed by some fibrous septa, similar in appearance to the covering. They all radiate from the point where the epididymis and blood-vessels enter. In between them are some fine white tubes (the tubuli seminiferi), which are best seen when floated out in water. They can be shown by a careful dissector to be continuous with the epididymis. They can be easily pulled out with a pair of forceps and unravelled.

THE FEMALE PERINÆUM.

List of important Structures.

External generative organs, including clitoris and fourchette.	Triangular ligament.
Position of urethra.	Muscles and vessels (smaller than in the male).

There is not so much difference, as at first sight there might appear to be, between the male and female perinæum.

The corresponding parts in the two sexes are best illustrated in the case of an hermaphrodite. The

divided scrotum at once proclaims its homology with the labia, and the small retracted penis assumes the appearance and position of the clitoris.

Before commencing the dissection of the female perinæum, the student will have no difficulty in recognising the labia majora, or outer lips of the vagina, and the labia minora, or inner lips. Just at the juncture of these, in front, is situated a small body, the clitoris, and immediately below it the orifice of the urethra. Into this a probe or catheter should be passed, so as to determine its direction.

At each side of the vagina, and just internal to the labia minora, are the openings of the ducts of the glands of Bartholin. There is one duct on each side, and in a fresh body they can usually be found after a careful search, and a probe or bristle passed into them. The glands themselves are situated a little way up the wall of the vagina.

Uniting the labia majora and minora of the two sides behind, the student should look for a transverse fold of mucous membrane, which is called the fourchette. It is of considerable importance in determining whether a woman has borne children, as it is usually ruptured at the birth of the first child.

Stretching across the mouth of the vagina, immediately inside the labia minora, is the hymen. A ragged edge of mucous membrane is sometimes seen in this situation, after the hymen has disappeared. It has received the name of *carunculæ myrtiformes.*

The skin incisions will correspond with those in the male, except that the one near the middle line starts from the symphysis, and passes all round the vagina, as well as the rectum, both of which cavities must be well stuffed with tow.

The ischio-rectal fossæ must be dissected, and the nerves sought for in the same manner as in the male.

The sphincter vagina, very similar in appearance to that of the rectum, must then be searched for and dissected, by cutting away the labia majora.

The deep layer of the superficial fascia will be found beneath the superficial fat, attached, as in the male, to the rami of the ischium and pubes; it can be inflated to show its connections.

Underneath it, attached to the rami of the pubes, are two muscles, the erectores clitoridis, which must be traced to their destination on the clitoris.

The clitoris itself must be carefully dissected, by removing all connective tissue from its surface. There will then be no difficulty in determining that it consists of two symmetrical halves, the two corpora cavernosa, but, unlike the penis, it does not contain a corpus spongiosum.

As in the case of the penis, a transverse section of it must be made, to display further the structure of the corpora cavernosa, and their pectiniform septum, which is quite rudimentary.

If the corpora cavernosa be traced downwards a great plexus of veins will be discovered on each side, just outside and a little behind the labia minora. It is enveloped in fibrous tissue, and is more or less pear-shaped. This is called the bulbus vestibuli. The two bulbi are homologous with bulb of the urethra in the male.

Internal to these structures, just under the mucous membrane at the commencement of the vagina, two rounded bodies, about the size of a horse-bean, will be seen when the mucous membrane is removed. These are the glands of Bartholin, the ducts of which have been already seen.

During the course of this dissection, some transverse muscular fibres (transversus perinæi) arising from the sides of the rami of the pubes, will have been brought into view. They lie in a similar position to

the same muscle in the male, and, like it, consist of several separate fasciculi.

When this muscle, together with the erector clitoridis, and the small accompanying vessels, are removed, the triangular ligament is reached; but, as has been before pointed out, so much of the space which it occupies in the male is in the female taken up by the vagina (Fig. 18), that it will not be so easy to distinguish it as in the other sex.

Parts seen when the abdomen is opened.—When the abdominal cavity has been opened by the incisions just described, the following structures will be seen (Fig. 14):

Bladder (if distended).
Small intestines.
The great omentum.
Transverse colon.
Lower portions of descending and ascending colon (perhaps).
Sigmoid flexure and cæcum may perhaps be partially visible.
Stomach.
Lesser omentum, if the liver be lifted up.
Liver, right and left lobes separated by falciform ligament.
Gall bladder (the tip).
Spleen (perhaps the edge).
Round ligament of liver.
Urachus.

The actual position of the viscera must be accurately compared with the surface markings which have been already alluded to. (*Vide* page 110, and Frontispiece.) The student will have no difficulty in verifying the various viscera: he can, if necessary, refer to a work on descriptive anatomy.

He must remember that the abdominal viscera will have to be learnt in the following manner. First, their actual position and relations to the body wall; secondly, how they are maintained in their proper places, or, in other words, the reflections of the peritoneum which attach them to the body wall; and lastly, their blood and nerve supply.

In order to get an idea of the general *arrangement of the peritoneum*, the student must, for the moment,

imagine the abdomen emptied of its contents, and in their place certain isolated masses; for example, the liver on the right side, and a mass of intestines in the middle.

These organs, be it remembered, are lying quite loose, like a heap of books upon a floor, or a heap of stones in a street. In order to prevent them changing their situation, except to a very limited extent when the body alters its position, they require to be supported, and this is effected by folding the peritoneum over them. The peritoneum is usually described as a closed sac; that is to say, it is like a pillow-case without a hole through which to insert the pillow. If this sac, consisting, of course, of two layers, be placed over the organs in question, and fixed firmly to them and to the walls of the abdomen on either side, the organs will be securely maintained in position, and immovably fixed there. In order to get at them when so fixed it will be necessary to cut through two layers of pillow-case. Cutting through the first will bring us into the cavity which the pillow would occupy, and we shall then see the second layer firmly adherent to the organ in question on its anterior surface, and also to the body walls.

It is clear from this description that the organ which has been referred to will *only* be covered on its anterior surface by the sac. This mode of arrangement will be more readily understood if reference is made to the Fig. of peritoneum in transverse section (page 119), where the colon will be seen to be covered in the manner just described.

But many portions of the viscera are quite movable, and they do not touch the body wall at all; they are suspended in a fold of the sac, just as a man might be suspended in a sheet, the two sides of which are attached to the ceiling close together, and are adherent all the way down until they are separated by the man's body. In this case, the viscus will be

completely surrounded by the fold, as will be seen by referring to the small intestines in the same Fig., and it will be able to move within certain limits, which will be determined by the length of the fold which attaches it to the body wall, and which is technically called a mesentery. It is by passing between the two layers of the mesentery that the vessels and nerves reach the intestine.

It only remains to consider where the anterior layer of the sac which does not touch the viscera is attached, and the student will have obtained a general idea of the arrangement of the peritoneum. This anterior layer is firmly adherent to the front wall of the abdomen, and is termed the parietal layer, whilst that portion which covers the viscera is called the visceral layer.

From this description it will be clear that the dissection which has been performed so far has brought the student into the sac of the peritoneum, the outer layer of which is adherent to the body wall, whilst the inner layer still covers the intestines which are brought into view. The further complications in its arrangement which must next be studied, are brought about by the alterations in situation which the viscera undergoes during the process of development.

The student will do well to bear in mind that during life there is no unoccupied space in the sac of the peritoneum, because the visceral and parietal layers touch one another, only a few ounces of fluid intervening.

The **arrangement of the peritoneum.**— In order to learn the arrangement of the peritoneal folds, it is best to study it first in its longitudinal section, and then at one or two situations in the transverse section.

By following the directions here given, and by the aid of the accompanying diagrams, the student

ought not to find much difficulty in understanding the arrangements of the various peritoneal folds.

These folds are called mesenteries, omenta, and ligaments. It is easier to remember that they are all folds, to start with, and then later on to give them their special names.

Strictly speaking, the terms mesentery and mesocolon mean the membrane which is attached to the small, or large intestine; omentum, a membrane containing fat; ligament, a band that unites one part to another. But in the case of the peritoneum, the word mesentery is now applied to those folds of peritoneum which attach the intestines to the body wall; omentum, to a fold that unites one viscus to another; whilst the term ligament is a more general one, but is employed usually for thin bands of peritoneum.

Peritoneum traced in vertical section.—It is best to start tracing the peritoneum from the middle of the parietal layer, on the front wall of the abdomen, about the umbilicus. Reference to the accompanying diagram may be of assistance. (*Vide* Fig. 20, page 144.)

From this point the student must pass his finger along its smooth inner surface; he will have no difficulty in following it up to the under surface of the diaphragm. If he push his hand up between the diaphragm and the liver from the front, he will, towards the back of the diaphragm, come to a place where he can advance no farther. This is the place where the parietal layer joins the visceral. It can then be easily traced over the anterior surface of the liver to its under side, and from thence as a thin membrane to the lesser curvature of the stomach, over its front surface to form the great omentum, which hangs down from it like an apron.

If the great omentum be lifted up, and turned up on to the ribs, the peritoneum will be traced round

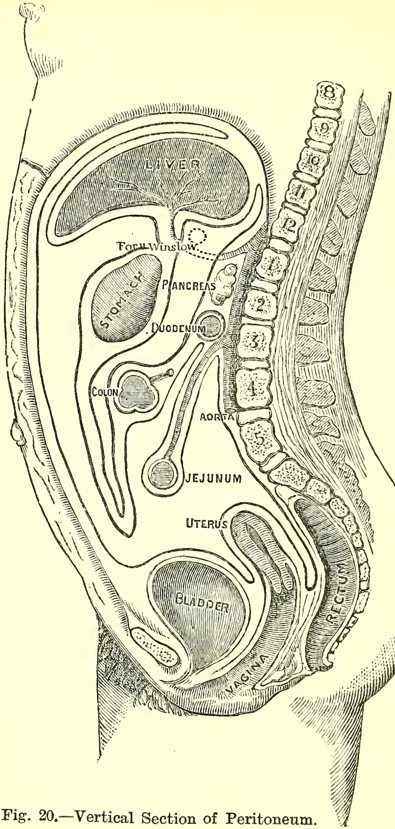


Fig. 20.—Vertical Section of Peritoneum.

the under surface of the transverse colon to the vertebral column, about the level of the second lumbar

vertebra. The vertebral column can be readily felt through it with the fingers. From this point it starts again and makes a bag for the small intestines, the neck of which is attached to the vertebral column from the second lumbar vertebra on the left side to the right iliac fossa, and is called the mesentery. To demonstrate this point, turn the small intestines to one side, and place a piece of string against their mesentery, taking care that it extends well above the upper end and well below the lower. Now turn the small intestines to the opposite side, and tie the two ends of the string together; it will be found to encircle the mesentery, and can be left for the present.

Turn the small intestines upwards so as to display the under surface and border of the mesentery; the peritoneum will be seen to bulge down into the pelvis over its brim. It almost merits a separate description, as it is quite a separate part, and liable to a separate inflammation, pelvic peritonitis.

The **pelvic peritoneum** can be traced from the rim behind, over the rectum, to form at first a mesentery for it, and permitting its movement, and lower down covering it only on its anterior surface. It is then reflected over the top of the bladder, to the abdominal wall, and runs up again to the umbilicus, forming the parietal layer.

The student will readily see, if he distend the bladder with air or water through the urethra, that when the organ is full, that portion of it which is not covered by peritoneum extends at least two inches above the pubes in the adult; hence, as will be seen presently, there is no anterior peritoneal ligament attaching the bladder to the pubic bones (Fig. 14, page 112.)

Where the peritoneum passes from the bladder to the sides of the pelvic brim, its folds have received the name of the lateral ligaments; and so, again,

where it passes from the rectum to bladder the folds are termed the posterior ligaments of the bladder, and form the sides of the recto-vesical pouch.

In the female there is seen between the bladder and the rectum an additional prominence, formed by the projection of the uterus. Folds of peritoneum will be seen passing from it to the rectum behind, and to the bladder in front. The pouch which is formed between the uterus and rectum in the female, is termed Douglas' pouch, and it is of great importance to bear this pouch in mind in connection with diseases of the uterus.

Stretching from the side of the uterus to the sides of the pelvic brim are two well-marked folds, the broad ligaments; and quite at the back of these ligaments, situated on the edge of brim, two masses (the ovaries) about as large as a thrush's egg.

Peritoneum in transverse section.—Just above the iliac crests and umbilicus (*see* Fig. 16) the continuity of the peritoneum should again be traced transversely.

Beginning in the centre of the parietal portion behind the recti, it can be traced backwards along the wall of the abdomen, till it reaches the ascending colon, which it covers on its anterior surface; it is then reflected over the small intestines forming the mesentery, and subsequently invests the front surface of the descending colon, after which it again returns along the abdominal wall to the point we started from.

The next transverse section, which is taken through the stomach, will be found to be far more complicated, owing to the fact that the stomach has, during the process of development, turned over on to its right side, and by so doing shut off a portion of the peritoneal cavity, which has received the name of the lesser cavity of the peritoneum. The entrance into the lesser cavity has been so narrowed by the hepatic

artery that it is only a small opening, which admits one or two fingers. It is called the foramen of Winslow, and in order to find it the student should pass his finger along the front surface of the stomach towards the pylorus. When he has reached this

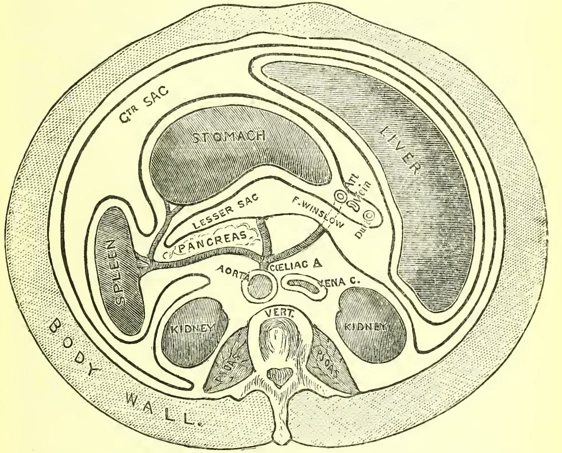


Fig. 21.—Section of Peritoneum through Foramen of Winslow.

point, he will find his finger slip backwards, and just above the duodenum it will enter a round hole, which leads to what is now the back surface of the stomach, but which was originally its right side. This is only another instance of that rule of development which is alluded to elsewhere, that when a part of the body changes its position during development, the right side becomes posterior and the left assumes an anterior position.

In tracing this section it is best to begin as before,

in the middle line of the parietal peritoneum. Its continuity must then be traced towards the left side with the fingers, when it will be found to pass under the ribs, over the kidney (*vide* Fig. 21, page 147), and then leave the abdominal wall to pass to the spleen, which it invests on its outer side completely, and to a less extent on its inner. It subsequently passes over the front of the stomach to reach the foramen of Winslow. The student will understand better the course of the peritoneum in this section if he will bear in mind that just as the intestines are moored to the back wall of the abdomen by a mesentery, so the stomach was once moored by a mesogastrium (stomach mesentery), in which the spleen is developed ; so that in reality the peritoneum has now been traced from the kidney up the left wall of the mesogastrium.

It next descends the right wall of the mesogastrium, which is so lengthened by the turn the stomach has taken to the right as to be scarcely recognisable. In other words, it enters the foramen of Winslow, passes behind the stomach to the hilus of the spleen, returns over the front of the vertebral column covering the aorta and vena cava, emerges again from the foramen of Winslow, and, passing over the right kidney, ascends once more to the parietal layer in front.

In order to demonstrate the size, shape, and relations of the lesser peritoneal cavity, the student must push his finger into the foramen of Winslow and downwards, till he reaches the lower border of the stomach, taking care not to break through the peritoneum anywhere. This is a very necessary caution, as inflammation has sometimes caused abnormal adhesions of the peritoneum to take place, so preventing the folds from being made out.

When the student's finger reaches the lower border of the stomach, he will see it through the great omentum, which must then be cut with a pair of

scissors or knife, so as to expose his finger, and the incision carried on along the lower border of the stomach for about three or four inches, taking care not to cut any large artery across.

Through the slit thus made the student can insert his whole hand, and make out the reflection of peritoneum which has just been described.

When this is done he must leave the lesser cavity for the present, as further dissection will only destroy important relations.

The next thing to be done is to trace the intestines upwards from the rectum to the stomach, and ascertain to what extent they are covered by peritoneum; in doing so the student will obtain a greater insight into and mastery over the peritoneal foldings.

In the cavity of the pelvis, that portion of the rectum which rests on the sacrum will be seen, and if laid hold of between the thumb and finger will be found to be fixed *in situ*, as it has no mesentery. Higher up, the rectum inclines to the left to reach the sigmoid flexure, which is situated in the left iliac fossa. The upper part of the rectum and sigmoid flexure both have a mesentery, or they would, when distended, impede the blood current through the iliac vessels, which they cross. Note that the sigmoid flexure is about twenty-two inches in length.

Passing up to the descending colon, it will be found to be firmly fixed to the back of the abdomen, and to be covered only on its anterior surface by peritoneum; usually about one-third of the circumference is uncovered.

The transverse colon is completely covered by peritoneum, and is connected with the back of the abdominal cavity by means of the transverse mesocolon, and with the lower border of the stomach by the great omentum, which also hangs down below it. (*Vide* Fig. 20.)

The ascending colon, like the descending, has no mesentery; but on reaching the cæcum, the peritoneum will be found to envelop completely that part which is nearest the small intestine, whilst the portion which rests in the right iliac fossa, and is closest to the large intestine, is covered only in front. Hanging from the outside of the *large* intestine, the student will notice some pedunculated masses of fat, called appendices epiploicæ.

The small intestines will be easily seen to be surrounded with peritoneum, and attached by their mesentery, round which a piece of string has been tied. The upper end of this piece of string should be surrounding the junction of the duodenum and jejunum, but if it has slipped, there will not be the slightest difficulty in deciding where the duodenum ends; for it lies almost transversely across the spine, and, being uncovered by peritoneum behind, is firmly fixed, whilst the succeeding jejunum is freely movable.

Before any dissection has been begun, the student will not easily make out the exact situation of the duodenum, crossing the spine as it does to ascend to the pyloric orifice of the stomach; but the stomach can be made out to be surrounded entirely by peritoneum, if the student passes his hand through the cut that has already been made in the great omentum, in order to display the lesser cavity of the peritoneum, and feels its smooth back surface.

When this has been done, he can put his hand up under the ribs of the left side, where he will find the spleen on the left of the stomach, and examine its complete covering of peritoneum.

The student will find, too, that he can get his hand all round the liver, except at its upper and back part; and when he dissects the lesser cavity of peritoneum, that one lobe of the liver (the Spigelian) looks into it. (*Vide* Fig. 22.)

DISSECTION OF THE INTESTINES.

Small intestines below duodenum.	Lesser cavity of peritoneum.
Large intestines, sigmoid flexure, and cæcum.	Duodenum, pancreas, stomach, and spleen.
Lesser omentum and its contents.	Liver.
	Diaphragm, and structures which perforate it.

DISSECTION OF STRUCTURES BEHIND PERITONEUM.

Solar plexus, and remainder of sympathetic system in abdomen.	Thoracic duct and receptaculum chyli.
Aorta and its branches.	Kidneys and ureters.
Vena cava inferior, and vena azygos.	Lumbar plexus, psoas, iliacus, and quadratus lumborum.
	Side view of pelvis.

Dissection of small intestines below duodenum.—That portion of the small intestine which has a mesentery, and may therefore be said to move on a universal joint, should first be removed, as it is easily learnt, and is liable to get in the way. As it is all supplied by the superior mesenteric artery and vein, and by nerves which accompany them; and as the blood and nerve-supply of each part of the small intestine is similar in arrangement, it is only necessary to select any six inches and dissect them carefully to understand the arrangement throughout the remaining part. Any six inches may be selected with the corresponding mesentery. The injected vessels will probably be seen through the mesentery, unless it is very fat. The layer of mesentery which overlies the vessels should be seized with the forceps, cut through, and carefully stripped off, so as to clean the arteries and veins. Close beside them, if the body is a fairly good one, will be seen some fine greyish-white fibrils, which are the nerves. When once found, the vessels can be easily traced up to the main trunk of the superior mesenteric, by cutting through the inferior

layer of the transverse mesocolon, when they will be seen to disappear from view between the duodenum and the pancreas. With care and patience the nerves may be traced as well.

Sometimes the student can obtain a view of the vessels and nerves of the small intestine by a method which is at once rapid and effectual, viz., by stripping off the peritoneum with his thumb and finger. To do this, he must make two parallel cuts, about two inches apart, reaching as nearly as possible to the exact depth of the vessels. The cuts must be extended from the intestine to where the mesentery is attached to the spine, and must be joined by two similar transverse cuts. If the two upper corners be dissected up for about a quarter of an inch, they can be seized between the thumb and finger of each hand, and the flap which has been marked out can be torn off in the direction of the intestine. It is very likely that an excellent view will be obtained; if not, attempts can be made till the method succeeds, as the process is a very rapid one.

When the dissection of the vessels is complete, the intestine must be tied below the duodenum, and at the lower ends of the small intestines. To avoid spilling the contents of the bowel, it is best to tie it across above and below, with two pieces of string about an inch apart, and to divide between them.

It must then be separated from the mesentery with a knife, so as to remove it from the body, and the mesentery itself can be cut away from the spine.

About twelve inches of intestine from the upper end should be preserved for inspection, and twelve from the lower; the rest may be buried.

Those portions which are preserved can either be opened at once or kept till a more convenient season. It is far better to open them at once, as they only

make a smell if left lying about, and often never get dissected at all.

They should be held under the tap, and their contents washed out, after which they can be slit open along the attachment of the mesentery with a pair of scissors, and floated out in water.

On the inside of both, if they are fairly fresh, some velvety projections will be seen, which float up in the water. These are the villi. In the upper part of the intestine the mucous coat is thrown into well-marked folds called valvulæ conniventes.

In the portion of intestine which abuts on the cæcum, there will be seen on the opposite border to that occupied by the mesentery some greyish-looking masses, about the size of a kidney bean or smaller, with pits in them about the size of a pin's head. These are Peyer's patches.

The student should particularly note the difference between the jejunum and ileum. The jejunum is very much thicker, contains abundant valvulæ conniventes, and no Peyer's patches, whilst the ileum is thinner, contains very few if any valvulæ conniventes, and about two dozen Peyer's patches. Solitary glands are found all along the whole length of the small intestine. They consist of small pits about the size of a pin's head, and are sometimes like little craters in the centre of a raised patch.

If the mucous membrane be rubbed off with the thumb and finger as it lies in the water, the subjacent muscular coats will be exposed. If the intestine is very fresh, it will be necessary to dissect off the mucous coat.

The student will then be able to make out, if he hold the piece of intestine up to the light, that the fibres on the inside run circularly, whilst those outside have a longitudinal direction. The outer ones are covered by the smooth peritoneal coat, which can be

stripped off with comparative ease, if it be seized at the edge. The student will then see how different a piece of intestine is which is covered with peritoneum from one which is not so covered.

Now that the small intestines with their mesentery are removed, the student should examine once more the attachment of the mesentery, which he can easily get at; and clean with a piece of tow or a sponge the peritoneal cavity.

Dissection of large intestine.—To get at this portion of the intestinal tract the great omentum must be turned upwards and stretched as far as it can be, without tearing it, over the edges of the ribs; a good view will then be obtained of all the large intestine as far as the rectum. The right half of the large intestine is all supplied by the superior mesenteric artery, from which the ilio-colic, colica dextra, and media are derived, whilst the colica sinistra, sigmoidea, and superior hæmorrhoidal are derived from the inferior mesenteric artery. These vessels will all be seen, almost certainly before the peritoneum is divided, supplying those portions of the intestine which their name indicates, and they must be cleaned along with the accompanying veins, and also the nerves if they can be found.

If the nerves were found in the mesentery they ought also to be found here. If the subject is so fat that the vessels cannot be seen through the fat, they must be traced downwards from the trunk of the superior mesenteric, which was found when the small intestines were dissected. The colica media will be found to anastomose so freely with the sinistra and dextra, that it is difficult to know exactly where one ceases and the other begins.

When the dissection of the large intestine, including the cæcum and sigmoid flexure, is complete, its position and relations should be once more passed

in review before removal. Its relations to the spleen, kidneys, liver, and duodenum, are of special importance.

Afterwards it may be removed, just as the small intestine was, by cutting through the peritoneum close to it, taking care to avoid cutting off the vermiform appendix of the cæcum.

Where the intestine passes over the left side of the brim of the pelvis to become the rectum, it must be tied across in two places, an inch apart, and severed in between them.

When it is removed it is better to examine it at once.

The large intestine should be cut across two or three inches above the cæcum, and the end of the ileum with the cæcum washed out under the tap. The cæcum should be blown up and its ends tied. It may then be left to dry, so as to display the ilio-cæcal valve.

If a fresh specimen of the valve be examined, it will be found that if the longitudinal fibres at the junction of the large and small intestines be divided a little traction will serve to obliterate the valve, which is merely an infolding of the mucous membrane, containing a few circular muscular fibres. In the dry specimen the two cusps of the valve will be well seen, the superior one being horizontal, and the inferior vertical in direction.

Before the ascending colon is slit up for the purpose of examination, it must be carefully washed at the tap.

It will be found to differ from the small intestine in being larger and thicker. It is traversed by three longitudinal bands of muscular fibres, which, being shorter than the gut itself, cause it to pouch out, and it has attached to it some tags of fat, called appendices epiploicæ, which have been already noticed during the examination of the peritoneum.

It can now be slit open and floated out in water. The student will notice that there are no villi in its mucous membrane, and no Peyer's patches, though on careful examination some small pits may be seen at intervals; these are exactly the same structures as the aggregated pits in the Peyer's patches, but not being collected together in a patch are called *solitary*.

Dissection of lesser omentum.—The position of the lesser omentum, stretching as it does from the liver and the lesser curvature of the stomach, has already been made out.

At its right edge, just in front of the foramen of Winslow, are three structures of great importance, the hepatic duct on the right, the hepatic artery on the left, and the portal vein between the two. Their relative position can easily be recollected, if it is worth while doing so, by bearing in mind the relative position of the structures from which they come. To expose them, pull up the liver towards the under surface of the ribs, and secure it with hooks to the chest wall; the omentum will be exposed, and the three structures lying in it will be felt between the thumb and finger, if the student inserts his finger into the foramen of Winslow, and his thumb on the front surface of the mesentery.

The front layer of the omentum should be seized over the vessels where it is fairly thick, and not over the lesser curvature, where it is very thin, and dissected carefully off, when the vessels will be exposed as above described. They cannot be traced farther at present without destroying important parts.

Dissection of lesser cavity of peritoneum.—In order that the student may not lose sight of the exact position and relations of the foramen of Winslow as dissection proceeds, he should obtain a piece of stick about six inches long, and pass it through the foramen into the lesser cavity.

The time has now arrived to dissect this cavity. In order to expose it to view, cut away the great omentum from its attachment to the stomach, except where the vessels are which have just been dissected. They must be studiously guarded from injury. Remove all the remains of the great omentum as far as the spleen, and the remnants (if there are any) of the transverse mesocolon.

The stomach can now be lifted up, and its greater curvature secured with hooks to the ribs,

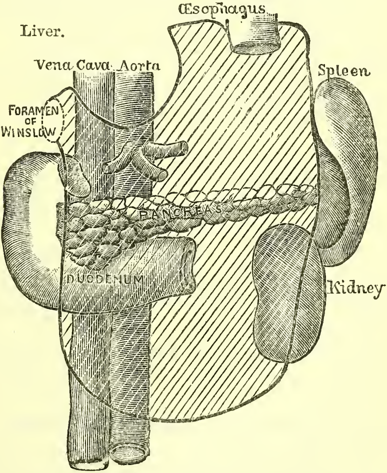


Fig. 22.—Lesser Cavity of Peritoneum. Showing its Extent when examined from in front.

when an almost complete view of the lesser cavity will be obtained, excepting only that part which came down into the great omentum below the stomach, and has now been destroyed.

From the accompanying Fig. an idea may be

obtained of the structures which abut upon it behind and all round, and which may be seen or felt. In front it is roofed in only by stomach, lesser and great omentum.

The student should put his hand up to the left of the aorta, and he will then feel the left pillar of diaphragm, and a part of its under surface, before he reaches the hilum of the spleen and the kidney. He will very possibly see a large mass of injection above the duodenum in place of the pancreas, this owing to the fact that the arteries of the pancreas are often burst by the injection. Indeed, a *good* pancreas is a thing rarely seen in the dissecting-room.

List of Structures, etc., to be made out in Connection with the Dissection of the Duodenum and Stomach.

Relations of three parts of duodenum.
Extent to which they are covered by peritoneum.
Pancreas and its duct.
Spleen.
Stomach.
Arteries:
  Cœliac axis.
  Gastro-epiploica, dextra and sinistra.
  Pancreatico-duodenalis, superior and inferior, etc.
Portal vein and its tributaries.
Gall bladder:
  Cystic duct.
  Hepatic duct.
  Common bile duct.
Dissection of liver *in situ* and when removed from the body.
Relations of all these structures to the peritoneum.
Examination of interior of stomach, pylorus, and duodenum.
Dissection of under-surface of diaphragm, and passage of structures into thorax.

The **dissection of the duodenum and stomach.**—The stomach has been secured with hooks to the edges of the ribs to display the lesser sac; the same position is a good one for the dissection of the duodenum.

If room enough cannot be obtained, owing to the viscera in this situation lying in the concavity of the diaphragm, a little more space can be got by taking the lower ends of the false ribs (excepting the last

two) between the thumb and finger, and breaking them across subcutaneously. When this has been done they can be everted, so as to give more space, without injuring any of the soft parts.

The outline of the duodenum will be perfectly clear, and so will the foramen of Winslow with a piece of stick in it, but the pancreas will be hidden by the peritoneum, and probably will not show through it.

Dissect the peritoneum carefully from the duodenum, working from the left side, where it is tied across, and has been seen to be continuous with the jejunum ; the duodenum will be observed to descend slightly towards the right after it has crossed the vertebral column, and to be uncovered by peritoneum behind. Above this part of the duodenum is situated the pancreas, and its head fits into the concavity formed by the second part of the duodenum which ascends. This part must next be divested of peritoneum, which will be found to cover it in front only, whilst behind it lies on the kidney.

Above the kidney the duodenum is again freely movable, and is therefore completely surrounded by peritoneum,* which should be stripped off so far as it can be, to expose the vessels and nerves.

As a rule, this part of the abdomen in the dissecting-room is not easy to make out well, partly owing to the bursting of the pancreas, and partly also because of the fluid and moisture which accumulates in an abdomen ; but if the part be really a good one, the vessels and nerves about to be described can be well seen. The relations of the duodenum, pylorus, and pancreas should be thoroughly mastered first, and their exact situation, with regard to the front and back of the cavity of the abdomen, made out, as they are of *great importance.*

* Though the duodenum is usually described as having a complete investment at this point, this is not always the case.

If the student will lay hold of the bile duct which he found in the lesser omentum, and pull it slightly,

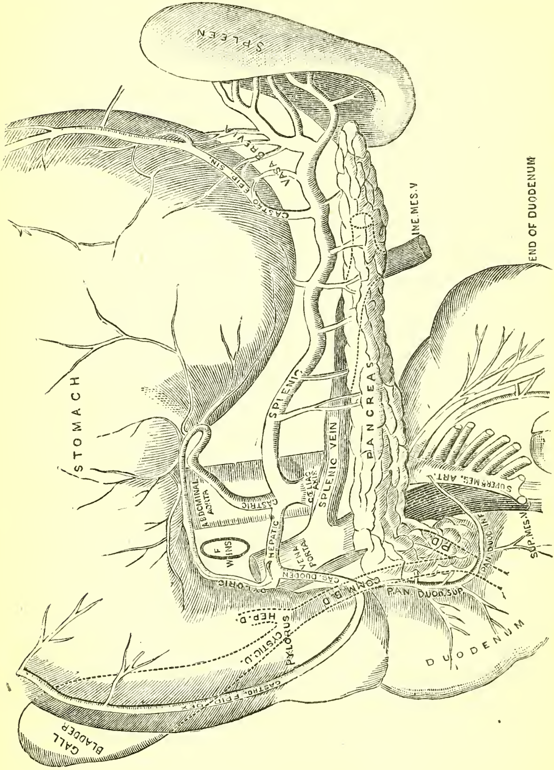


Fig. 23.—Cœliac Axis and its Branches. (*From* Gray's "Descriptive and Surgical Anatomy.")

he will be able to trace it down on the inner side of the middle part of the duodenum, where it enters the

bowel; and entering the common bile duct near its end he will find the pancreatic duct which runs in the substance of the gland and should be traced towards the left by cutting it away.

The relations of these structures, and of the portal vein and arteries of this region, may be rendered clearer by the diagram (Fig. 23).

The left end of the pancreas will still be covered with peritoneum, which must be dissected off. As the student gradually uncovers it, he will also uncover, just above it, the tortuous splenic artery, giving off some small branches (pancreaticæ parvæ) to the pancreas.

As this artery is traced on towards the left, the spleen will be reached, and the vasa brevia will be exposed going from the splenic artery to the stomach, the posterior layer of the gastro-splenic omentum having been just removed. If the student is in any difficulty about this artery, he may be assisted by reference to the transverse section of the peritoneum through the foramen of Winslow. (*Vide* page 147.)

Passing upwards (in this position of the body) from the splenic artery, the gastro-epiploica sinistra artery can be traced along the greater curvature, to anastomose with the gastro-epiploica dextra from the hepatic, which will be dissected later on.

The splenic artery should next be traced backwards to the cœliac axis, more peritoneum (back wall of lesser sac) being removed to expose it. The gastric (coronary) artery may be felt towards the highest part of the lesser sac, curving round its left side to get to the œsophageal end of the stomach; after arriving at this point it gets between the layers of the lesser omentum, and runs along the lesser curvature of the stomach to anastomose with the pyloric branch of the hepatic. The hepatic may be felt winding round the right side of the lesser sac, and below the foramen of

Winslow, towards the pyloric end of the stomach, at which point it turns upwards, round the stick which was inserted into the foramen of Winslow, to get between the layers of the lesser omentum. It will be seen to give off a branch that descends slightly on the duodenum, the gastro-duodenalis. The gastro-duodenalis divides almost immediately into the gastro-epiploica-dextra, which has already been alluded to as coursing along the greater curvature of the stomach, and into a small branch, the pancreatico-duodenalis superior, which lies between the head of the pancreas and the duodenum, and anastomoses with the pancreatico-duodenalis inferior from the superior mesenteric. To expose these arteries the peritoneum simply requires to be stripped off.

Portal vein.—To the right side of the superior mesenteric artery, and almost behind it, is the corresponding vein, which, like the artery, has been cut across. If the student push a probe or his blowpipe gently up its open mouth, it will pass behind the pancreas and reach the portal vein, which will probably need a little more dissection to expose it completely.

By pulling the pancreas down a little with forceps or hooks, and tracing the portal vein downwards, the splenic vein, which lies behind the pancreas, will be found to join it. In fact, it is the junction of the superior mesenteric and splenic which forms the portal. Trace the splenic vein outwards, and about midway between it and the spleen another vein, the inferior mesenteric, will be found to enter it. The pancreas will need to be almost removed before the junction can be clearly seen.

Corresponding with the pyloric branch of the hepatic artery and the coronary artery of the stomach, two veins will be found which usually empty into the portal.

If the body is a very good one, some small sympathetic nerves may be found by the side of the arteries and veins coursing up towards the cœliac axis.

When all the above parts have been thoroughly made out, the stomach must be turned down once more, so as to trace the portal vein up to the liver, and likewise to demonstrate the fact that it is the junction of the cystic and hepatic ducts which forms the common bile-duct.

The student should not be in a hurry to remove these parts if the abdomen is a good one, for their relations are difficult both to dissect and understand, and it is better to arrange with the dissector of the thorax (*vide* Dissection of thorax, page 186), to trace the continuity of the structures which pass from the thorax into the abdomen, which cannot be done until the thorax is almost completed, so that the diaphragm and lower ribs may be cut away, and thus give a better view of the parts which the student has before him.

Dissection of liver.—Before the diaphragm can be cut away the liver must be dissected, so the student must for a while leave the stomach and duodenum, and dissect the liver. Those portions of it which are in relation with the greater and lesser peritoneal sacs have already been made out; the portion which is not covered by peritoneum is in contact with the diaphragm, and cannot be seen till the liver is removed from the body

The hepatic duct, portal vein, and hepatic artery, which lie in the lesser omentum, have all been traced up to the portal fissure.

The relationship of the foramen of Winslow to the liver has been seen; and if the student feel with his finger behind the second part of the duodenum he will detect the right kidney, and can trace its upper border, and feel (if he cannot see) that it

touches the back part of the right lobe. He will also remember that the duodenum and hepatic flexure of the colon also touch the under surface of the right lobe, in the order in which they have been mentioned, from behind forwards.

To remove the liver, divide the falciform and round ligaments with a knife or pair of scissors; pull the liver out from the concavity of the diaphragm, and cut through the other folds of peritoneum (its lateral and coronary ligaments) which connect it with the diaphragm.

Divide the vena cava at its upper and back part, and again about an inch lower down as it runs through a little piece of liver. Its whereabouts on the right side of the vertebral column will have been made out, and a little care will avoid any mishap.

Cut through the structures which were contained in the lesser omentum, about an inch from the liver, which can be lifted out of the body for further dissection.

Dissection of liver when removed from body.—More properly speaking, the liver requires rather to be examined than dissected after it has been removed from the body.

If the student will refer to the accompanying sketch of the liver, which has been copied from Quain's "Anatomy," with slight additions, he will have no difficulty in making out its various parts.

He must trace upwards the round ligament along the umbilical fissure to join the portal vein, and also its continuation (a fibrous cord), along the fissure of the ductus venosus to the inferior vena cava on its upper surface.

The cut ends of the portal vein, hepatic artery, and duct should be traced right into the portal fissure, and the liver cut open (when all the rest of its surface is finished), in order that these structures may be seen

to subdivide. The artery, vein, and duct will be seen to travel together in distinct canals (portal canals) in

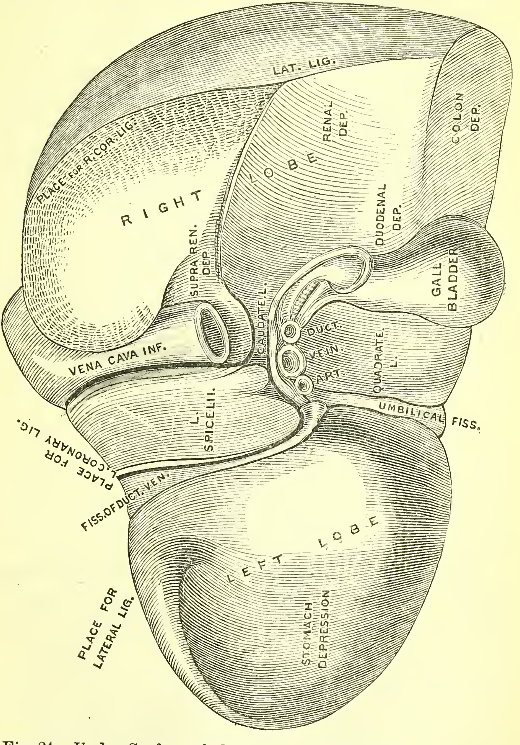


Fig. 24.—Under Surface of the Liver. (*From* Quain's "Elements of Anatomy.")

the liver substance, gradually breaking up smaller and smaller till they are too small to dissect.

If an incision be made into the liver substance, the portal canals which have just been described may be seen, if carefully looked for, and some larger holes (the hepatic veins), which appear as open, and not as collapsed, tubes like the portal veins.

The very small lobules will also be seen on the surface of the section, with a small vein (intralobular) in their centre. They are polygonal in shape, and about a sixteenth of an inch or more in diameter.

Surrounding the Spigelian lobe he will trace the cut edge of peritoneum belonging to the lesser sac.

On its upper surface he can see the two lateral and coronary ligaments, and in between the latter the rough surface, which was in contact with the diaphragm, and is uncovered by the peritoneum. The liver substance is not quite exposed, but is covered with a layer of connective tissue called Glisson's capsule.

It is as well to remember that it is not usual to see so large a surface of the right lobe uncovered by peritoneum as is represented in this sketch.

The student usually finds it difficult to make out where the lateral ligaments end and the coronary begin. In this sketch, where there are two layers of peritoneum in contact, they are called lateral ligaments, but where layers are separated by a portion of uncovered liver the ligaments are called coronary.

Dissection of under surface of diaphragm as far as the œsophageal opening, and removal of stomach and duodenum.—Now that the liver has been removed, the under surface of the diaphragm should be cleaned, as far as the level of the œsophageal opening. To effect this, the peritoneum must be carefully dissected off from the circumference towards the centre. If a good start be made, the hand or some blunt instrument may be introduced between the peritoneum and the diaphragm, and it can be rapidly stripped off.

Any connective tissue which remains after this is completed should be carefully dissected off, in order to display the origin of its fibres from the cartilages of the ribs, and their insertion into its central tendon.

The under surface of this part of the diaphragm must be carefully learnt, and the opening of the vena cava looked for. There will be no difficulty whatever in seeing in, or in passing a finger through it into the right auricle.

In company with the dissection of the thorax, the diaphragm, together with any ribs that are in the way, must be removed as far back as the œsophageal opening.

By this means the continuity of the stomach and œsophagus will be made quite clear, and the two vagi which have already been seen on the œsophagus should be followed down to the stomach. The left on the front of the stomach can be traced by careful dissection as far as the beginning of the duodenum, and the right into the solar plexus.

The stomach, duodenum, and spleen should now be removed by severing the œsophagus just above the cardiac orifice. When this is done, the stomach and duodenum must be opened, so as to dissect their mucous, muscular, and peritoneal coats, precisely in the same manner as this was performed in the rest of the intestines, taking care to observe the longitudinal muscular fibres along the greater and lesser curvatures of the stomach, and the presence of villi and valvulæ conniventes in the duodenum.

When the stomach mucous membrane has been stripped off, the oblique fibres of the stomach which are the most internal will be exposed.

Do not omit to examine the pylorus, and to see the thickening of the coats at this point, and the narrowing of its calibre, giving rise to a sort of valve.

Dissection of structures behind peritoneum, and of diaphragm behind œsophageal opening.—The branches of the sympathetic system which accompany the intestinal vessels have already been dissected as far as it is possible, but the principal plexuses of the abdomen still remain.

In order to discover the solar plexus, the peritoneum and connective tissue should be carefully dissected off the right crus of the diaphragm, the divided lower end of the vena cava being drawn downwards. Passing through the right crus (almost underneath it) will be found a white cord, nearly as large as the vagus (the great splanchnic nerve). If any difficulty be experienced in finding the splanchnic, it is better to lay hold of it in the thorax, where it ought to have been already dissected, and pull upon it; no difficulty will then be experienced in tracing it down to the large semilunar ganglion of the solar plexus which lies at the sides of the aorta, behind the vena cava. The solar plexus consists of the two semilunar ganglia on each side of the cœliac axis. They receive the splanchnic nerves at their upper ends, and at their lower ends are united below the cœliac axis by numerous nerve fibres. There is no difficulty in tracing the right vagus from the back of the œsophagus to the right semilunar ganglion, and seeing it make a loop with the right splanchnic (the loop of Wrisberg).

If the body is a good one the student will have no difficulty in making out the plexus, and tracing numerous branches (if he spend time enough) along the various arteries, to the renal, suprarenal, and diaphragmatic plexuses, along the corresponding arteries. By tracing these nerves onwards, he will find a plexus situated around the renal vessels, to which the lesser splanchnic nerves usually go, whilst other nerves can be traced down the aorta; and from it

branches can be dissected which run over the brim of the pelvis to a plexus between the iliac arteries, called the hypogastric, which will be dissected later on.

Just below the crura of the diaphragm, and behind the renal vessels, the main sympathetic chain, with a ganglion corresponding with each vertebra, should be traced to the brim of the pelvis. From these ganglia branches can be traced forwards to interlace with all the nerves in their proximity.

When the branches of the sympathetic system have been made out, the rest of the peritoneum and areolar tissue, which envelop the vena cava, aorta, kidneys, and back of abdomen, will need to be removed.

There is, as a rule, no difficulty in this; the structures have long before had their situations indicated, so it only remains to clean them, and to make out the branches and relations of the aorta and vena cava, and the situation and relations of the kidneys.

When stripping the connective tissue off the muscles at the back of the abdominal cavity, care must be taken to avoid injuring the branches of the lumbar plexus which lie on them. The nerve most likely to be injured is the genito-crural, which emerges from the psoas on its inner and front surface, and which lower down lies on the external iliac-artery.

The common and external iliac artery and vein must be carefully cleaned and their relations studied, but the internal iliac artery and vein, along with the other structures in the pelvis, must be left to be dissected with the side view of the pelvis.

At the top of the kidney, resting on it like a cap, is a small body from one to two inches across (the suprarenal capsule), which has already been mentioned by anticipation, when numerous branches from the solar plexus were traced to it, upon the arteries

which each receives from the aorta. On a very good subject the suprarenal bodies may be seen to return their blood on the right side to the vena cava, and on the left to the renal vein.

The student should put his hand into the two pleural cavities above the diaphragm, and see that he can by this means get to the back of the kidneys, both of which rest partially on the diaphragm.

Having cleaned the renal arteries and veins, there will be seen coming out of the hilum of the kidneys, behind them, two tubes, the two ureters, which should be traced as far as the brim of the pelvis.

Two small arteries, very long and thin, from the aorta, should next be traced (the spermatic). They can easily be followed as far as the internal abdominal ring, to form one of the constituents of the cord; and from the ring upwards their corresponding veins will be traced, that on the right entering the vena cava, whilst the left pours its contents into the left renal vein.

The kidneys must now be pulled away with the hand from the back wall of the abdomen, so that they are attached only by their vessels and ureters, and can be afterwards replaced, so as to show their relation to the diaphragm and ribs. This will enable the remainder of the diaphragm, comprising the crura, arcuate ligaments, and aortic opening, to be dissected.

The crura have already been seen, one on each side of the aorta; they are muscular in structure above, and tendinous lower down, where they arise from the lumbar vertebræ. They must be carefully cleaned, like any other muscle; their origins can usually be traced on the right side as low as the fourth lumbar-vertebra, and on the left side to the third.

If the crura be traced upwards as far as the level of the last rib, they will be seen to join over the front

of the aorta, and then go on to surround the œsophageal opening.

The kidney has been separated from the back of the abdominal wall, and can therefore be turned forward so as to expose the last rib. When this has been done, there will be seen running along the last rib, just at the upper border of the quadratus lumborum, an aponeurotic arch, the ligamentum arcuatum externum, which can be traced inwards to the tip of the transverse process of the first or second lumbar vertebra. The diaphragm will be seen to take origin from this ligament.

Winding round the upper end of the psoas, from the place where the external arcuate ligament ends to the body of the same vertebra, is the internal arcuate ligament, also giving part origin to the diaphragm. It is under this ligament that the psoas enters the cavity of the thorax.

These ligaments are only an aponeurotic thickening, which takes place at the point of junction of the fascia that covers the under surface of the diaphragm with the fascia (of psoas and quadratus lumborum) which belongs to the back wall of the abdomen.

The remainder of the diaphragm must be cleaned by taking the fascia off, beginning from the arcuate ligaments and crura and working upwards, care being taken not to injure the phrenic arteries and veins and splanchnic nerves. When this is done, the aortic opening must be laid open, when the aorta will be seen to be crossed by a small aponeurotic arch in front, to have the muscular crura on either side of it, and to rest on the bony vertebral column behind.

If the aorta be slightly pulled over to the left side of the body, there will be seen descending to it from the thorax on its right side a vein (the vena azygos major), and, between this vein and the aorta, the thoracic duct. It is better to pull on the thoracic

duct in the thorax, where it has already been found, if any difficulty is experienced in finding it at this point, and its whereabouts will then be made clear.

As was described in the dissection of the thorax, it is possible to distend it with air by means of a blow-pipe, or with fluid by the aid of a syringe. (*Vide* page 199.)

Usually on the point of the body of the second lumbar vertebra, the thoracic duct is seen to dilate to form the receptaculum chyli, which is about three-quarters of an inch or more in length, and of variable diameter.

The vena azygos must be traced down on the side of the vertebral column, where it will be seen to receive branches from the body wall, particularly from the lumbar region (lumbar veins).

Through the aortic opening the sympathetic sometimes passes ; but it has been already traced piercing the crura. The student will remember that the sympathetic nerves usually pierce the crura, and *may* pass under the internal arcuate ligaments with the psoas.

The origin of the psoas from the sides of the vertebral column must be traced, and likewise its insertion into the lesser trochanter. Round the lumbar artery and vein, where they disappear between the psoas and the vertebral column, an aponeurotic arch of fibres should be traced, from which some of the fibres of the muscle take origin.

Dissection of the lumbar plexus.—The psoas and iliacus, and quadratus lumborum, having been divested of their fascia, there will be seen lying upon them the various branches of the lumbar plexus, as they emerge from the psoas muscle.

The plexus itself is situated in the substance of the psoas muscle.

Beginning from above downwards, the following nerves will be seen :

Just below the last rib, and running parallel with the ligamentum arcuatum externum, are the last dorsal artery and nerve. Next to this follow two others, the ilio-hypogastric, and below it the ilio-inguinal. If this latter nerve is traced onwards, it will be seen to pass either just inside, or just over the top of the iliac crest.

These three nerves should be traced into the substance of the abdominal muscles, which they can be seen to supply; their cutaneous branches were made out when the abdominal wall was dissected. (*Vide* page 113.)

Emerging from beneath the outer border of the psoas, about where it crosses the iliac crest, is the external cutaneous nerve; it can be traced across the iliacus muscle to the inner side of the anterior superior spine of the ilium, to disappear under Poupart's ligament, and supply the outer side of the thigh.

By tracing the psoas downwards to where it disappears under Poupart's ligament, and lifting up its outer edge, a large nerve (the anterior crural) will be found.

Lying in front, and a little to inner side of the psoas, and emerging from it somewhere about the level of the third lumbar vertebra, is the genito-crural nerve, which makes its way down to the region of the internal abdominal ring, lying generally in relation with the external iliac artery. One branch (the genital) can be traced into the internal abdominal ring, whilst the crural passes down into the leg under Poupart's ligament.

The student must not be surprised if he cannot find this nerve exactly as it is here described, as it is subject to some variation, and its place may be partly taken by some other branch of the lumbar plexus, usually the ilio-inguinal.

Emerging from the inner and under surface of the

psoas, close to the brim of the true pelvis, is the obturator nerve. If the peritoneum which descends into the pelvis be dissected away from the brain, the nerve will be found between the bifurcation of the iliac arteries, running round the cavity of the pelvis, about three-quarters of an inch below the brim to the upper part of the obturator foramen. Quite underneath the psoas another nerve, the accessory obturator, may occasionally be found. It passes down into the leg, over the brim of the pelvis, and not through the obturator foramen. The best way to discover it is to turn up the inner edge of the psoas just where it crosses under Poupart's ligament, and look for the nerve, or else trace it downwards from the obturator nerve, or the lumbar plexus close to it.

In order to dissect the lumbar plexus itself, it is better to trace one of its large branches upwards. The external cutaneous or anterior crural answer best for this purpose. The muscular substance of the psoas must be gradually removed during the progress of the dissection, and the other branches which have been seen will be readily traced. Should any difficulty be encountered in finding their connections with the plexus, they can be gently pulled upon with the forceps so as to make out their whereabouts.

The main branches of the plexus must be traced inwards to the intervertebral foramina, and when the psoas has been thoroughly removed from the sides of the vertebral column, a further piece of the lumbar arteries and veins, and their accompanying sympathetic nerves, will be seen.

Arrangements should be made at this stage with the dissector of the leg, so that the continuity of the structure reaching from the abdomen to the leg may be clearly made out.

Poupart's ligament should be cut away from its attachments when the hypogastric, ilio-inguinal, and

genito-crural nerves have been traced to their ultimate distribution, the whole length of the external cutaneous, anterior crural, and probably the obturator nerves, will be brought into view, together with the psoas and iliacus muscles, and the exact origin of the pectineus.

SIDE VIEW OF THE PELVIS.

List of Structures to be Dissected.

Removal of leg from trunk.
Distension of bladder, vagina, and rectum.
The pelvic fascia.
Folds of peritoneum.
Relations of viscera to peritoneum and fascia.
Course of vessels and nerves to the various viscera.
Removal of viscera and their dissection.
Dissection of sacral plexus and sympathetic ganglia in pelvis.
The cavity of the true pelvis, its muscles, vessels, and nerves.

When all the dissection of the abdomen is completed, the pelvis may be begun. In order to get at it satisfactorily, one leg, with the corresponding innominate bone, must be removed. The left leg is usually taken away.

To remove the left leg and innominate bone, the following incisions should be made. A big and strong knife should be employed, and it will run very considerable risk of being blunted before the leg is separated. The knife should be carried from the anterior superior spine round the crest of the ileum, keeping close to it, and removing all the remains of the abdominal muscles from it. The peritoneum must be completely raised from the left side of the pelvic cavity, from the symphysis in front to the sacro-iliac synchondrosis behind, but not taken away.

The pubes should be sawn across, about half an inch to the left side of the symphysis, care being taken to ensure that the saw does not injure the structures behind the pubes. Very often when this is

accomplished, the innominate bone can be separated at the synchondrosis by placing one hand on each iliac crest, and using considerable force. If it does yield, the knife should be employed to divide, at the level of the brim of the true pelvis, the common and internal iliac artery and veins with the ureter, the psoas, and anterior crural nerve.

The rectum must be separated from the synchondrosis and turned over towards the middle line, after which any other structures that cover up the articulation must be cut through.

The saw should then be applied with great care to the region of the synchondrosis, until it is so far cut through that it can be easily broken.

This will allow the left innominate bone to be readily turned outwards. As this is done the fascia should be cut from the upper and lower margins of the pelvis, and detached by pushing the handle of the knife between it and the obturator internus. This will partially expose the levator ani, running from the ischial spine to the back of the pubes. The tip of the ischial spine should be cut off with the saw or bone forceps, and left with the parts attached to it.

Just above the ischial spine, and coming through the great sacro-sciatic foramen, the pyriformis muscle and the gluteal and sciatic vessels and nerves must be severed as they pass through the foramen. The structures which pass through the *lesser sciatic* notch should be preserved. The division of the great sacro-sciatic ligament close to the ischial tuberosity will complete the separation.

The dissection of the innominate bone which has been removed belongs to the leg.

To display their relations, the viscera of the pelvis must now be distended.—The rectum and vagina, if it is a female, if not already distended by tow, should be at once stuffed. The penis

was cut short in the dissection of the perinæum. The cut end of the urethra should be sought under the pubes in front, and a catheter or sound passed into the bladder. If no sound or catheter is at hand, the student can bend his blow-pipe slightly at the thin end, and pass it gently down the urethra till it is evident it has reached the bladder. He will be able to feel it in the bladder with his finger. Whatever instrument he has employed for the purpose must be tied tightly in, by binding the stump of the penis round with a bit of string.

The bladder must then be distended through the blow-pipe, or, if a catheter or sound is used, a small hole can be made into the bladder somewhere, and when the bladder is distended the hole can be secured with a bit of string. Another good plan is to push the blow-pipe by the side of the sound, and so distend the bladder.

When the viscera are all distended, their general relationship will be at once apparent, and should be borne in mind.

The **pelvic fascia must next be dissected,** and its connections ascertained.

The best method of doing this is to lay hold of the little piece of ischial spine which was left behind, tie a piece of string round it, and fix it to a block placed by the left side of the lumbar vertebra of the subject, or any other suitable place. Follow along the fascia which is attached to this spine, and which is of a good thickness, till the place is arrived at where it is attached to the pubes. With a needle a piece of string can be affixed to it here too. This will enable it to be put on the stretch in any situation that the dissector wishes.

Just behind the bulb of the urethra, the student will remember he saw the anterior layer of the triangular ligament when he was dissecting the perinæum.

The most dependent part of this must be seized, and, with the aid of the needle, the student should pass a piece of string through it, by means of which it can be put on the stretch.

When the fascia is fixed as just described, dissection may be commenced after the folds of peritoneum have been made out.

The peritoneum itself will probably hardly need any dissection to display it, forming a covering over the

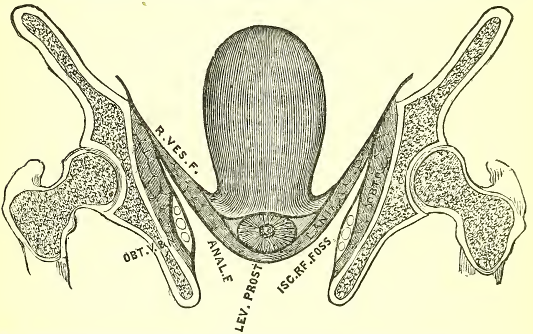


Fig. 25.—Bladder and Prostate, showing the Lateral True Ligaments (recto-vesical fascia).

upper surfaces of the pelvic viscera. If there is any difficulty in discovering how far it comes down towards the outlet of the pelvis, this will be rendered clear at once if the student put his hand into the peritoneal cavity, and pass it down gently between the viscera.

It is important to observe the distance of the end of the recto-vesical pouch from the anus. It is usually about a finger's length. The folds of peritoneum which pass from the sides of the pelvis over the top of the bladder are called the lateral false ligaments. The fold which surrounds the urachus forms the superior false ligament. The peritoneum passing from

the bladder to the rectum, and forming the sides of the recto-vesical pouch, are the posterior false ligaments; these portions of peritoneum afford no support, and hardly deserve to be called "ligaments."

If the layer of fascia which is held at each end by pieces of string be traced, after removal of the peritoneum, it will be found to be continued as a thickish white layer on to the sides of the bladder, whilst farther back it passes in a similar manner to the sides

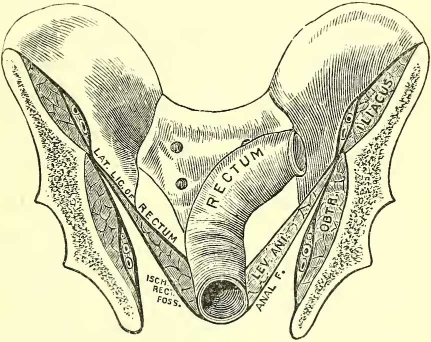


Fig. 26.—Diagram showing the relation of the Recto-vesical Fascia and Levator Ani to the Rectum.

of the rectum (Fig. 26). In front it is continued on to the prostate, splitting to form a capsule for it.

This fascia must be carefully cleaned; it will be found to cover the upper surface of some muscular fibres (the levator ani). A scheme of its arrangement will be seen in the diagrams of the pelvic fascia (Figs. 25 and 26), where it is named recto-vesical. Its attachment to the side of the pelvis was cut away along with that of obturator fascia and levator ani, when the left half of the innominate bone was removed.

If the fascia be turned upwards against the side

of the rectum and bladder, after being dissected off the levator ani, the upper surface of that muscle will be exposed, and should be cleaned. It can be traced downwards to the side of the rectum, and farther in front some of its fibres pass beneath the prostate, under the name of the levator prostatæ. These should be carefully cleaned. They will be seen represented diagrammatically in Fig. 25 of the pelvic fascia.

Underneath this muscle a very thin fascia (anal) can be seen, which passes down to the sides of the anus, and can be traced, though with difficulty, to form the inner boundary of the ischio-rectal fossa.

The triangular ligament, which has already been found and put on the stretch, should next be dissected. Its front surface has already been cleaned. Passing through both its layers, the student will readily feel the sound that indicates the situation of the urethra. He must carefully clean away the tissue that lies between the two layers of the triangular ligament, and he may perhaps find, if his part is a good one, a round body about the size of a pea (Cowper's gland), lying between the layers of the compressor urethræ, which should be looked for passing above and below the urethra. When these structures are cleaned, it will be clearly seen that the posterior layer of the triangular ligament is directly continuous with the recto-vesical fascia, and is therefore described by some authors as being formed from it.

From the upper part of the prostate the recto-vesical fascia can be traced on to the back of the pubes (pubo-prostatic ligaments).

The folds of recto-vesical fascia at the side of the bladder form its lateral true ligaments, and the termination of these in front (over the prostate) form the two anterior true or pubo-prostatic ligaments. The urachus forms the fifth true ligament of the bladder. To understand these folds of fascia, if he cannot make

them out entirely on his own part, the student should refer frequently to the diagrams of the pelvic fascia, and then endeavour to verify the diagrams.

When once the course of the fascia in the pelvis has been demonstrated, the relations of the rest of the structures will be easy.

Before passing on to the vessels, it will be better to examine the opposite side of the pelvis, and trace again the connections between the recto-vesical and the rest of the pelvic fascia.

To effect this, the peritoneum must be stripped off the wall of the pelvis, where it forms the lateral false ligament of the bladder. This should be done in the same way as it was performed on the left side.

At the edge of the brim of the true pelvis the fascia will be clearly seen to be attached to the bone, and must then be traced downwards all round the cavity. It will be found when cleaned to be thick, and to cover the bone, and lower down the obturator internus. From this fascia the recto-vesical will be seen to be given off, and can be traced to the neck of the bladder and side of the rectum. Where the recto-vesical fascia begins to be given off from the obturator, a line is seen stretching all along its attachment. This is generally known by the name of the white line, and is due to the fact that the fascia is thickened where the recto-vesical is given off.

If the pelvic fascia be traced backwards, it can be seen to lie in front of the sacral nerves, but behind the branches of the iliac artery, *i.e.*, between them.

The rectum should be divested of all its connective-tissue covering and carefully dissected, so as to show its muscular coat, and the position it occupies with reference to the sacrum and coccyx behind, and the peritoneum, bladder, or vagina and uterus in front.

By dissecting in front of the rectum, and following the ureter downwards, it can be traced into the

bladder. The student should notice that the air with which he inflated the bladder rarely if ever escapes by the ureter. This is owing to the fact that the ureter enters the bladder obliquely, and so has a sort of valved orifice, which prevents regurgitation. It can readily be seen when the bladder is open, by passing a probe down the ureter, and cutting down upon its course.

Passing onwards, under the base of the bladder, the student will readily feel some firmer masses (vesiculæ seminales), but will not see them till they have been carefully dissected, as they are covered with a very dense fascia, which is continued inwards from the recto-vesical. They should be cleaned, and the vasa deferentia followed until they join the ducts of the vesiculæ.

By following these structures onwards under the base of the bladder, after it has been pulled to the right side, the prostate will be reached, and should be completely exposed on its left side by dividing the upper part of the lateral true ligament of the bladder.

The trunk of the internal iliac artery, where it was divided, should be fixed, and the vessel and its branches, as well as those of the artery of the opposite side, carefully cleaned. There will be no difficulty in tracing the three vesical arteries which come from them. The upper becomes continuous with the obliterated hypogastric, which has already been seen; the middle supplies the lower part of the bladder and vesiculæ seminales; the inferior vesical, now that the lateral true ligament of the bladder has been cut away, can be traced to the prostate and neck of the bladder.

The middle hæmorrhoidal branch should be traced on to the rectum.

On the right side the obturator artery is seen lying on the obturator fascia, and must be traced to where it leaves the pelvis at the obturator foramen, a small

branch being seen to pass onwards behind the pubes to anastomose with a similar (pubic) branch of the opposite side. Veins, corresponding with the arteries, will be seen forming a plexus round the prostate, and in the female round the vagina and neck of uterus.

Some few sympathetic branches can sometimes be traced a little way down the arteries, but they cannot be followed far without special previous preparation of the part.

Those branches of the sympathetic which were seen to pass over the common iliacs during the dissection of the abdomen, can be traced to form a plexus (hypogastric), situated on the front of the sacrum, just below its promontory. To clean this at all well requires much time and patience.

The bladder, uterus if there is one, and rectum must next be entirely divested of peritoneum, and cleaned away from all connection with the pelvic wall, except at the lower outlet. They can then be pulled out of the pelvis, and its right inner wall cleaned and examined.

The sacral plexus and the pyriformis must be cleaned, and the small nerves which enter the muscle on its front surface should be looked for coming from the sacral plexus.

Running down the middle of the sacrum will be seen the sacra media artery, and on either side the sympathetic chain may be traced down from the abdomen.

The pelvic cavity will now be about completed, excepting only the dissection of the viscera themselves.

Before removing the viscera, they should be replaced once more *in situ*, and their relations again passed in review.

The air should be allowed to escape from the bladder by making an incision into it above, the

student should then observe the exact situation of the mouth of the urethra. He will see that it is, when the body is erect, the most dependent part of the bladder. The parts will have been so altered in relation by dissection that this may not be so now. The best way to determine this point is to examine the bladder in a post-mortem room.

The viscera must now be removed by carrying the knife close round the edge of the lower aperture of the pelvis.

The bladder and urethra should be removed carefully from the vagina or rectum, whichever it is that lies behind it.

It should be carefully washed both inside and out, and laid upon a table. It is better not to remove the catheter until the urethra has been slit open with a pair of scissors on its upper surface, or there is oftentimes a difficulty in finding the urethra at all.

The relationship of the bladder to the prostate and vesiculæ seminales and vasa deferentia should then be carefully examined.

The openings of the ureters should be looked for, and the valvular aperture, to which reference was made above, examined. A piece of the mucous membrane of the bladder should be stripped off, to see the inside of the muscular coat.

The prostate, when divested of its fibrous coat, will be seen to consist of three lobes, a middle and two lateral. In a young and healthy prostate these lobes are not very well marked, but are in most old people. Some hard concretions may be found in the prostate gland substance.

The urethra will be seen to pass through the prostate. On the floor of the prostatic portion of the urethra, which is about an inch and a quarter in length, will be seen the opening of the two vasa deferentia, between which is a larger depression, the

uterus masculinus (the homologue of the female uterus), which is situated at the top of an elevation, called the caput gallinaginis. Some small ducts, some twenty in number, open from the prostate gland at a depression (prostatic sinus) on the floor of this part of the urethra. This depression is situated at each side of the caput gallinaginis.

Below the prostate, as has been already seen, the triangular ligament is situated, and lying between its two layers is the membranous portion of the urethra, about three-quarters of an inch in length.

Beyond this again is the bulb, which has already been seen in the perinæum to be the bulbous end of the penile or spongy portion of the urethra.

The rectum must be slit open and examined, just as the other portions of the intestine were. There is nothing special to see in it, except two or three folds of mucous membrane (Houston's folds).

If the body is that of a female, the vagina and uterus, when separated from the body, need further examination. They should be washed and laid upon a board; the vagina must be opened with a pair of scissors along its upper surface. Internally it will be seen to be covered with rugæ, probably not very well marked at this stage. The cervix and os uteri will be displayed by slitting open the vagina. The student should look to see if the orifice is that of a virgin, small, round, or transverse, or whether it is large enough to admit of his little finger, and irregular and torn in outline. If so, it is the os of a woman who has borne children.

A pair of scissors should be passed up the os, and the cervix and cavity of the uterus laid open. The cervix (neck) will be found in the healthy uterus to be about an inch, and the cavity to be about an inch and a quarter, or inch and a half in length. A ready mode of recollecting these measurements, which

are very important, is to regard the cervix and uterus as each an inch and a quarter in length.

Passing away to the sides of the body of the uterus are the Fallopian tubes, and by continuing to trace them up, the ovaries, rather smaller than a testicle, will be seen, one on either side, attached by one end to the uterus, and by the other to the Fallopian tube. The Fallopian tube can be seen to have a fimbriated extremity, which is close to and, under certain circumstances, surrounds the ovary. Lower down the uterus than the Fallopian tube is the round ligament of the uterus, which has been traced up to the internal abdominal ring.

All these structures are seen to be inclosed in a covering of peritoneum called the broad ligament.

The folds of peritoneum which connect the uterus with the bladder and rectum are called its anterior and posterior false ligaments. There are two in front and two behind.

If the body is that of an old woman, the generative apparatus will be found to be much atrophied.

CHAPTER VI.

DISSECTION OF THE THORAX.

General considerations.—It is advisable to begin the dissection of the thorax as soon as ever the arms are removed, so as to see the thoracic viscera in as fresh a state as possible. It is also necessary to do so, on account of the difficulties which surround the dissection of the upper part of the abdomen and the lower part of the neck, before the thoracic viscera are removed.

The cutaneous nerves of the thorax have been already seen in connection with the dissection of the arm and back, and the muscles which are attached to the outer wall of the thorax have also been dissected and learnt, so that the inside of the thorax alone remains to be seen.

The relationships of the heart and great vessels, and the lungs, to the chest wall, are of the very greatest importance, but by the time that the chest is opened the lungs are collapsed, and the heart is so displaced that their proper positions are seldom seen in the dissecting room.

This alteration of position is due to several causes. If the body is injected from the aorta, the dissection necessary to get at that vessel is quite sufficient to account for its displacement. If any other vessel be chosen for the purpose, the aorta is usually so distended with injection, that it is often displaced nearly an inch from its natural situation. Lastly, if no injection be used at all, the thorax is almost certain to be punctured, or the air finds its way into it from the neck or the abdomen, and the heart and lungs are found nearer to the spinal column than to the chest wall. As if to add to the student's difficulties, many descriptions of the position of the heart, having been taken presumably from dissecting-room bodies, place it farther to the right side of the sternum than it really is.

The *exact*, or, more properly speaking, the *average* situation of the viscera, which are in a constant state of movement during life, can only be made out in one of four ways:—(1) By observations on the living body; (2) by frozen sections of the body made as soon as possible after death; (3) by inserting a series of skewers through the body as soon as possible after death, and dissecting the body carefully to see what structures and organs they have pierced; (4) by

dissecting the thorax before any other part of the body has been touched.

The account given in Holden's "Landmarks"* is accurate and concise.

Before attempting to dissect the thorax, the student is strongly advised to study well the bony framework in a skeleton. If possible, he should look at a body in which the thoracic and abdominal viscera have been removed, and the diaphragm left intact, so as to get a clear idea of its shape and situation.

A very cursory glance at the skeleton will enable any one to see that the ribs slope downwards, and therefore that their anterior extremities will be lower down than the part which is attached to the vertebral column. It is very important to bear this in mind, and also to learn which vertebra the front end of each rib is opposite to.

The three following points in front and behind will be found to be about opposite to each other, and can be seen to be so on a well-articulated skeleton. They should be carefully committed to memory.

(1) The upper end of the sternum (episternal notch) is opposite the lower border of the second dorsal vertebra.

(2) The junction of the first and second bones of the sternum is opposite the lower border of the fourth dorsal vertebra.

(3) The junction of the sternum and ensiform cartilage is opposite the lower border of the eighth dorsal vertebra.

The Fig. of the thoracic viscera (*vide* frontispiece) is intended to show their relationship to the chest wall. In the first diagram is seen their relationship to the front wall of the chest, and, in the

* For further information on the situation of organs, consult Braune's "Atlas of Topographical Anatomy," Sibson's "Medical Anatomy."

second diagram, to the back wall. The student should carefully compare the two diagrams, and with their aid learn to map out accurately all the viscera.

General description of thoracic viscera.—In order better to appreciate the relations of the viscera in the thorax, it is customary to describe it as follows :

On either side, and occupying by far the larger part of the thoracic cavity, are the two lungs in their serous sacs (pleuræ). The space which lies between them is called the mediastinum. It is usually divided into three, an anterior, middle, and posterior mediastinum. The middle is occupied by the heart and great vessels ; it is the largest of the three. The anterior mediastinum is the smallest, and occupies the space in front of the middle mediastinum, whilst the posterior lies in front of the vertebral column, and contains the descending aorta, œsophagus, etc.

General principles to be borne in mind during dissection.—It follows, then, from this description, that the proper way to dissect the thorax after having mastered the construction of its walls, is to inspect and learn the position of the lungs and pleuræ first, as their position is easily mastered, and then pass on to the three mediastina and their contents. After this is finished, the lungs must be completed, and the relationship of the structures that pass from the neck to the thorax, and from the thorax to abdomen, must be made out.

Before opening the thorax, the position of the viscera must be mapped out by the aid of some pins and pieces of string, and by referring to the diagram of the thorax. It is of the greatest importance that the student should be familiar with the surface markings of the heart and great vessels at the root of the neck.

DISSECTION OF THORAX.

Important Points in Thorax Wall.

Arrangement of two pleuræ in front, and their exact relationship to front wall of chest.	Triangularis sterni.
Anterior mediastinum (position, boundaries, and contents).	Intercostal muscles.
	Internal mammary vessels (perforating branches).
	Intercostal vessels and nerves.
	Ligaments of sternum.

Dissection of thorax.—Saw through the sternum just below where it is attached to the first rib, and again just above where it joins the ensiform cartilage. Cut through the muscles in the first intercostal space, as far back as the angle of the ribs. The muscles of the sixth or seventh intercostal space may be cut in the same manner, also as far back as the angle. The student must not fail to notice that by this incision he is dividing the parietal layer of the pleura as well as the muscles, and therefore cutting into the pleural cavity. The ribs, from the second to the seventh inclusive, must be cut through at their angles with a pair of strong bone forceps. The greater part of the front and side walls of the chest can then be removed in one piece.

This plan of removing the whole chest wall at once will be found to offer many advantages, as it permits any foul fluid that may have accumulated in the chest to be readily drained off, and leaves the constituents of the thorax wall readily available for dissection.

As a very large number of the bodies which are employed for dissection have at some time or other suffered from pleurisy, the lung and both layers of the pleura are often adherent to the chest wall. Some difficulty may therefore be experienced in its removal.

If this should be the case, the lung must be

dissected off as carefully as possible from the pleura, and not removed with it.

In a normal chest, when the chest wall has been removed as above described, it will be seen to be covered by a shiny membrane. This is the parietal pleura, the layer which is reflected on to the chest wall. The lung which is left behind is covered by a thinner layer of pleura (the visceral). The space which, after the chest has been opened, lies between these two layers is called the pleural cavity.

The **anterior mediastinum.**—It is important to see the exact line of attachment of the pleuræ to the sternum, as it marks out the lateral limits of the anterior mediastinum. Towards its upper part, just where the sternum is joined by the second costal cartilage, the pleuræ will be seen to be almost touching each other. Above this point they diverge like the two sides of one's waistcoat, and it is just behind the first bone, therefore, of the sternum that the principal contents of the anterior mediastinum are situated.

From the second to the fourth costal cartilages the two pleuræ are all but in contact behind the sternum, so that practically speaking there is no room left for the anterior mediastinum at this point.

At the fourth costal cartilage the pleuræ again become separated, owing to the rapid divergence of the left lung from the middle line. The space on the back of the sternum and costal cartilages, which is left between the pleuræ at this point, is occupied by the heart and pericardium.

As the heart is usually spoken of as lying in the middle mediastinum, it is obvious that there can be very little anterior mediastinum in this part of the chest.

It will be clear, from what has just been said, that by far the greater part of the anterior mediastinum is situated behind the first bone of the sternum.

The boundaries of the anterior mediastinum will be as follows : In front, the back of the sternum ; on either side, the two pleuræ ; behind, the pericardium in the lower part of the chest, whilst above there is no distinct boundary line between it and the middle mediastinum. The deep layer of cervical fascia which passes down behind the sternum to the pericardium is looked upon by some people as forming the posterior boundary of the anterior mediastinum above.

Dissection of back of sternum.—The student must now begin to dissect that portion of the chest wall which has been removed.

The pleuræ must be carefully dissected off from the inner surface of the chest wall, care being taken not to wound the vessels or muscles which lie underneath them.

In the middle, attached to the sternum, with its fibres radiating upwards and outwards, a muscle will be seen. This is the triangularis sterni. Its fibres must be cleaned ; where this has been done there will be seen, about three-quarters of an inch outside the sternum, on either side, an artery and two venæ comites. There will be no difficulty in seeing that they course between the cartilages of the ribs and the triangularis sterni.

These vessel are the internal mammary artery and veins. If they are traced upwards it will be rendered clear that the vessels of the left side are contained in the anterior mediastinum, whilst those of the right are not, owing to the fact that the anterior mediastinum is not quite in the middle line.

The fascia must next be removed from the intercostal muscles of one space, and when this has been dissected and learnt the muscles can be removed.

On the superficial surface of the internal intercostal (*i.e.*, between it and the external intercostal) the intercostal vein, artery, and nerve will be found. Towards

the front of the chest (*i.e.*, nearest the sternum) two arteries will be seen, one, the larger, running along the groove on the under surface of the rib, and another, much smaller, coursing along the upper surface of the rib below. If these two arteries be traced far enough back they will be found to come off from a common trunk, whilst if traced onwards toward the sternum, the larger one anastomoses with the internal mammary. The smaller one sometimes does so as well, but is usually lost in the muscles before it reaches this point.

If the internal mammary artery be laid hold of in the forceps, and pulled slightly, there will be seen to be a small branch which passes through each intercostal space, and is accompanied by a small vein and nerve. The terminations of these on the front wall of the chest have already been dissected under the name of the anterior perforating vessels and nerves, when the skin was removed during the dissection of the arm.

The student should not omit to satisfy himself by inspection whether there is an anterior branch to the nerve in the first intercostal space, as it is usually absent, or too small to be made out without special dissection. (*Vide* page 214.)

The lateral cutaneous nerves which pierce the intercostal muscles in the axillary line will be seen if search is made at that situation.

The sternum, with about three-quarters of an inch of the costal cartilages attached, should now be preserved for the dissection of the ligaments.

Ligaments.

Anterior and posterior costo-sternal.	Interarticular to second and third ribs.
Capsular.	

After clearing the sternum from all superfluous fat and muscle, it should be set to soak in water for

a few days, so that it may macerate a little. In warm weather a week is not too long, whilst if the water is very cold it will bear at least a fortnight's maceration without any harm. It should be looked at every day or two, and the loose tissue removed, taking care not to injure that part where cartilages and sternum articulate.

When the white glistening fibres that run across from the sternum to the cartilages begin to show themselves, the student will know that the time for dissection has arrived, and on cleaning off all the intervening tissue some fibres will be seen in front of and behind each articulation, which are called respectively the anterior and posterior costo-sternal.

If slices of cartilage be taken from the back or front surface of the costal cartilages, where they abut upon the side of the sternum, the joints, surrounded by their capsular ligaments, will be laid open, and it will be seen that the joint belonging to the second cartilage, and often that also belonging to the third, is divided into two by an interarticular ligament.

Excepting in children under puberty, it is difficult often to see these joints, and in old age they are almost invariably obliterated by the ossific union of the cartilages with the sternum.

The **lungs.**—Now that the anterior mediastinum is completed, the viscera of the thorax must be examined *in situ*, and their position, which has hitherto been learnt from their surface markings, verified as far as possible.

At any rate, there will be no difficulty in seeing that the lungs occupy the sides of the cavity, and that the left lung goes down farther than the right, owing to the diaphragm being pushed up by the liver on the right side.

If the lungs are adherent to the chest-wall, at their apices or elsewhere, they must be carefully separated, either by working at the adhesion with the tips of the

fingers or the handle of a scalpel. If the adhesions are very strong, dissection may be necessary to free them.

When the lungs are quite freed from any unnatural attachment which they may have acquired, they will be found to be connected with the rest of the thorax by the roots only, which are situated close to the middle line.

The student must put his hand into the chest, and verify for himself the exact limits of the pleural cavity, noting how far the apex extends above the upper thoracic aperture, the relations of the subclavian artery to it, and how large a part of the upper aperture it occupies. At the same time, he must bear in mind that the lung very rarely fills the pleural cavity, for the lung is an elastic bag, and, unless it is fully distended, leaves the extremities of the pleura unoccupied, in the living subject as well as in the dead. This is particularly the case in the lower part of the pleura. In consequence of this it is quite possible, if the liver be stabbed, to pass through two layers of pleura, and yet avoid the lung altogether.

The diaphragm had better be examined at this stage, and its dome shape observed. The student will then readily understand that its sides are flattened each time it contracts, and so enlarges the cavity of the thorax. It must be dissected when the viscera have been removed.

The **posterior mediastinum.**— If the two lungs are lifted up from the position in which they were lying when the chest-wall was opened, and the right and left hand of the student placed under the right and left lungs respectively, he will find that his fingers do not touch in front of the vertebral column ; there is something intervening. This is the posterior mediastinum, which lies on the front of the vertebræ, and has the pleura on either side of it, and the pericardium in front. Higher up above the level of the

pericardium there is no distinct boundary line to separate it from the middle mediastinum. A similar fact was noted about the anterior mediastinum ; hence this upper part of the three mediastina has been described by some authors as a "superior mediastinum."

That part of the pleural cavity where the student's fingers were brought to a standstill is the line of union between the parietal and visceral layers of the pleura, and an incision along the side of the vertebræ at this point will open the posterior mediastinum, and expose its contents.

Before making this incision, the process of pleura which attaches the inner and back aspect of the lung to the diaphragm must be looked for. It is about four inches long, and extends from the root of the lung to the diaphragm. It is called the ligamentum latum pulmonis, and cannot possibly be mistaken. The student must not fail to observe that there is no similar ligament above the roots of the lungs, owing to the fact that the vena azygos major winds round the upper edge of the right root, and the aorta round the left.

When this portion of the dissection is completed, the lungs can be cut away, about two inches from their roots. It is necessary to leave about two inches, so as not to destroy the pulmonary plexuses, but advisable to remove the rest, as they only add to the difficulties and discomfort of the dissector, and so are better out of the way.

If a sponge and some clean water be employed at this stage, it will materially aid the remainder of the dissection.

THE POSTERIOR MEDIASTINUM.

Contents.

Aorta.	Vena azygos.
Œsophagus and vagi.	Thoracic duct and lymphatic glands.
Splanchnic nerves.	

In order that the posterior mediastinum may be dissected, the right lung, or what remains of it, should be pulled forward slightly and turned over towards the left side, without cutting anything whatever.

Through the transparent pleura which still remains on those ribs that were cut off at their angles will be seen the continuation of the intercostal vein, artery, and nerve that have been already traced in the front part of the intercostal spaces. When they reach the vertebral column, the nerve will be lost. It goes towards the spinal cord, and can be traced later on; but the artery and vein are seen through the pleura to ascend, the former to the aorta, the latter to the vena azygos major. This vein, which is of considerable size, will be seen passing upwards to wind round the root of the right lung, and when the pleura is removed, will be seen to enter the vena cava superior, whilst below it can be traced down to pierce the diaphragm.

About the middle of the dorsal region, a whitish cord, or perhaps more than one, will be seen passing obliquely downwards and forwards on the vertebræ under the pleura. This is the great splanchnic nerve, and very possibly it can be seen to come from the sympathetic ganglia.

These ganglia are greyish-white masses, a little larger than an apple-pip; they lie on the necks of the ribs, and are seen to be connected by nerve fibrils.

If the left lung be lifted out of its situation, just as the right has been, the aorta, full three-quarters of an inch in diameter, will be seen lying on the left side of the bodies of the vertebræ.

The other structures that have been already seen on the right side will be seen on the left, excepting the splanchnic nerve, which is concealed by the aorta and the vena azygos, which only comes up as high as the sixth dorsal vertebra, and is not very noticeable

through the pleura. The left superior intercostal vein will probably be seen coming from the upper spaces, and crossing the aortic arch to join the left innominate vein.

The œsophagus will not be seen unless a piece of cane of some kind is passed down it. It is better to do this if the dissection of the other parts of the body is far enough advanced to allow of it, as the student will then readily grasp the situation of this important structure.

When this examination is completed, the posterior mediastinum should be opened by an incision on each side of the vertebral column, and its contents exposed by the removal of the cellular tissue.

The aorta has already been seen, and needs only to have the intercostal arteries traced to it. The œsophagus must be carefully dissected, and its relationship to the aorta made out and mastered, care being taken to avoid injuring the plexus of nerves which surround it just below the roots of the lungs.

The vena azygos on the right side will be seen to receive all the intercostal veins. Those of the upper one or two spaces unite to form a superior intercostal vein.

On the left side the vena azygos crosses over the spine at or about the level of the sixth dorsal vertebra, and joins the right azygos. The veins from the two or three upper left intercostal spaces open into the left superior intercostal vein, which has already been looked for crossing the arch of the aorta to open into the left innominate vein. The others empty separately into the right azygos, or else unite to form one or two trunks, which collect the blood, and then convey it to the right azygos.

The veins often vary considerably at this point, and the student should consult some work on descriptive anatomy, so as to understand the various arrangements. The senior student will derive much aid on this point by his knowledge of the development of the

veins. He must not omit to dissect out the superior intercostal vein on the left side, and see from how many spaces it collects blood, and trace it across the arch of the aorta to the left innominate vein.

The branches of the sympathetic ganglia must now be carefully dissected, and the three splanchnic nerves which come off from the six lower dorsal sympathetic ganglia carefully traced down to the diaphragm.

The upper or great splanchnic is usually derived by four or five roots from the sixth, seventh, eighth, ninth, tenth dorsal ganglia ; the lesser splanchnic has usually two roots from the tenth and eleventh, and there can generally be seen to be a third splanchnic nerve from the twelfth ganglion.

These nerves should be preserved, as they must eventually be traced through the diaphragm to the solar and renal plexuses, which are dissected with the abdomen.

Between the aorta and vena azygos major, and lying on the intercostal arteries, the student will discover, if he carefully removes the connective tissue, what looks at first sight like a small empty vein. This is the thoracic duct, which must be traced to the diaphragm, and upwards into the neck, to open into the junction of the subclavian and jugular veins.

Its relations in the upper part of the thorax must be very carefully studied, as they are often neglected, though of great importance.

In order to display the thoracic duct more readily, a portion of its wall must be seized with the forceps, and a small cut made in it. If the blow-pipe be inserted, it can be injected with air ; or a syringe may be used to introduce some coloured material.

The vagi will have been seen (one in front and the other behind the œsophagus) during the dissection of the posterior mediastinum. They should not be further gone into at this stage, but left till later, when the various nerve plexuses of the thorax are

dissected. Their general course, including their relationship to the roots of the lungs, will have been sufficiently made out.

The **middle mediastinum** occupies the remainder of the chest. The anterior and posterior mediastina have been so thoroughly dissected and learnt, that the student will have no difficulty in making out the relations, position, and contents of the middle mediastinum. The smaller structures which are contained in it, and the dissection of the heart and trachea, will be returned to later on.

The **phrenic nerve.**—Unlike the vagus, which passes behind the root of the lung, the phrenic nerve though entering the chest close to it, passes in front of the root of the lung, courses down the outer wall of the middle mediastinum, lying on the outside of the pericardium, and then pierces the diaphragm. There will be no difficulty in finding it on the side of the pericardium, and then tracing it upwards and downwards. There is a small artery, comes nervi phrenici, which accompanies it, and which forms a ready guide to its position.

If the pericardium is still untouched, it must be opened by a longitudinal incision extending upwards from the apex of the heart. If the body be perfectly fresh a few spoonfuls of fluid will be found in it; but it is rare to see this in the dissecting-room.

Examine carefully the position in which the heart lies in the body, as the subsequent dissection to display the nerve plexuses will render this impossible later on.

The **nerve plexuses of the thorax** will be dissected next. They are as follows, and may be dissected in the following order:

Cardiac plexuses (superficial and deep)
Coronary plexus.
Pulmonary plexuses (anterior and posterior).
Œsophageal plexus.

As has been before stated, when two corresponding structures in the body are not symmetrically placed, but are situated one in front of the other, it is almost the invariable rule that the one from the right side lies behind, whilst that from the left is in front. The cardiac plexuses form no exception to this rule. The right one, or rather that plexus which receives its nerve supply from the right side of the body, lies behind the transverse portion of the aorta and upon the bifurcation of the trachea, whilst the other cardiac plexus is situated in the concavity of the arch of the aorta.

In reality these two plexuses are so intimately connected that they might with almost equal propriety be described as one; but custom has long sanctioned their division into two, so this mode of description will be adhered to.

Supplying the cardiac plexuses there are in all ten nerves, three from the cervical sympathetic on each side, viz., one from each ganglion, and two from each vagus, a thoracic and cervico-cardiac branch. Of these two, only the left superior cardiac branch of the vagus and the left inferior branch of the sympathetic supply the superficial plexus, whilst all the rest go to the deep plexus.

Such is the ordinary description given of the cardiac plexuses, but the student must not expect to find this arrangement in every subject; and, indeed, if he take the trouble to examine many bodies, he will find that though this in the main is a correct description, yet the number and distribution of the nerves is subject to variation.

The left vagus has already been found; it only requires to be traced downwards to the arch of the aorta, where it will be seen to give off a good-sized branch that winds round the arch, the recurrent laryngeal. Coming off from the recurrent laryngeal,

or else from the vagus itself a little higher up, is another branch, the left thoracic cardiac. If this branch be traced downwards into the concavity of the arch of the aorta, it can generally be seen to join with another nerve, a branch of the sympathetic, which usually passes over the aortic arch; and their junction is generally well indicated by a grey ganglionic mass, the ganglion of Wrisberg.

The sympathetic nerve should, if possible, be traced upwards, when it will be usually found to terminate in the left superior cervical ganglion.

In close relationship to the arch of the aorta, and not very far, therefore, from this plexus, is the phrenic nerve, but it has no connection with the plexus.

In order to display the deep or great cardiac plexus, and at the same time do as little damage as possible to the surrounding structures, the right side of the cut pericardium, together with the right side of the heart, must be gently pulled over towards the left, and there held by hooks to the table or a block. Care must be taken not to injure the aorta, which, being tightly distended by injection, may be ruptured if too much stress is put upon it. (*Vide* page 203.)

By this manœuvre the front of the trachea will be exposed, and the deep plexus only needs a little dissection for its complete display.

To effect this, the right vagus must be traced downwards (it has been already found, lying on the side of the trachea), and it will be readily seen to give several branches, which unite with sympathetic branches to form the plexus. There will be no difficulty in tracing several branches forward to the superficial plexus; indeed, as has been already stated, they form in reality but one plexus.

The distance to which the cardiac nerves can be traced upwards, depends in great measure upon the fresh condition of the body, and upon the extent to

which the head and neck have been dissected. Without devoting more time than he usually has at his disposal, the student is hardly likely to see all the cardiac nerves; and in a bad body he can hardly expect to do more than trace the branches from the vagi to plexuses in the situation indicated.

The accompanying scheme of the deep cardiac plexus may assist in the remembrance of the distinctions and directions of the branches of the deep cardiac plexus (Fig. 27).

From the anterior and posterior cardiac plexuses, if the pericardium be removed, some branches can be

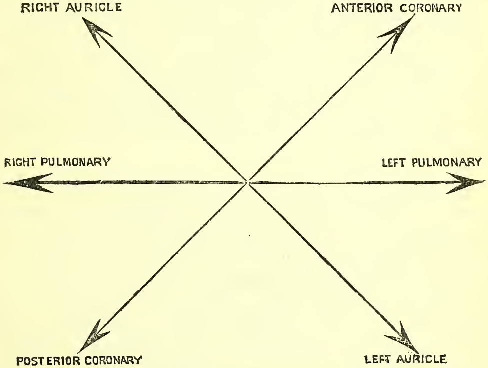


Fig. 27.—Scheme of Branches of the Deep Cardiac Plexus.

traced downwards to the anterior and posterior coronary plexuses. These plexuses follow the coronary arteries, and must be looked for upon them.

The branches from the plexus to the heart substance itself can rarely, if ever, be traced in a dissecting-room body.

It is usual to divide the aorta just above the

heart, before attempting to dissect the cardiac plexuses; but this plan so destroys the relations of the parts which the student needs always to bear in mind, that it is better to adopt the above-described plan, which, though harder to do, is far more effectual when once completed.

The **pulmonary plexuses** are so close at hand, lying in front and behind the roots of the lungs, that to display them the vagi require only to be traced onwards from the cardiac plexuses, and carefully cleaned.

Considerable care is requisite if they are to be well cleaned. They will be seen to surround the roots of the lungs, and to send branches to their substance, which follow the ramifications of the blood-vessels. The posterior plexuses of the two sides are so closely connected behind the roots of the lungs, that they form in reality but one plexus, and afford the best instance in the whole body of a complete communication between plexuses situated on different sides.

Sympathetic branches from the thoracic ganglia can be readily traced to these plexuses by exerting a little tension on the plexuses themselves, when the course of the nerves will be rendered more clear.

The **œsophageal plexus.**—After the vagi have broken up to form the pulmonary plexuses, they re-form into single trunks, which are situated on the back and front surfaces of the œsophagus, and, following the above-mentioned rule, the right is situated behind. This plexus begins about an inch below the roots of the lungs, and is of considerable size, extending almost as far as the diaphragm. By exerting a little tension upon it, some sympathetic nerves from the thoracic ganglia will be demonstrated to exist.

On emerging from this plexus, the two vagi maintain their position, and should be traced on to the œsophageal opening of the diaphragm.

Dissection of the heart and great vessels in situ.—The heart must be once more replaced in its natural situation in the body.

Passing upwards from the apex towards the base is a groove, usually fitted with fat, marking the separation of the right and left ventricles. Situated in this groove, a vessel (the left coronary artery) can be seen through the fat. It must be traced upwards on the left side of the pulmonary artery to the aorta.

On the right side of the pulmonary artery is the right coronary artery, and just above this is the right auricle, into which the two venæ cavæ open. The coronary arteries must be traced round the heart to their destination.

Accompanying them will be readily seen the corresponding veins, all of which eventually empty into the so-called coronary sinus, which is nothing but a large vein lying in the auriculo-ventricular groove at the back of the heart. To display this, pull the apex of the heart upwards.

On tracing this coronary sinus outwards towards the left side of the heart, a fold of pericardium of varying extent will be seen between the pulmonary artery and veins, and in this fold (the vestigial fold) lies the oblique vein of Marshall, the remains of the left superior cava and left azygos vein, which existed during fœtal life. The oblique vein extends from the left end of the coronary sinus over the root of the left lung to the left superior intercostal vein, and is most easily found by lifting the heart up and tracing the sinus upwards and towards the left.

In some of the lower animals these veins remain permanent in the adult. There is, therefore, in the situation of the coronary sinus a left superior vena cava, into which the cardiac veins empty. This is well seen in the horse.

To display the cavities of the heart, the vena cava, inferior and superior, should be joined by an incision, and the front wall of the auricle, including that of the auricular appendage, which curls over the origin of the aorta, must be cut away with a pair of scissors. This will expose the right auricle.

To display the right ventricle, push a knife in about a quarter of an inch outside the interventricular groove till it enters the ventricle, and then carry the incision down as far as the apex. The left ventricle must be opened by a similar incision, but as its wall is much thicker, the knife must be pushed in deeper before it reaches the cavity of the ventricle.

To expose the left auricle, the apex of the heart must be turned upwards, and an incision made parallel with and just above the coronary sinus. This will open the auricle; to display its cavity completely, the back surface will need to be removed, and the openings of the two pulmonary veins of the left side will be removed at the same time.

It is better to study the heart's cavities in the order in which the blood passes through them.

Most of the interior of right auricle is smooth, but that portion (the auricular appendix) which extends in front of the aorta presents a more or less *honeycombed* appearance, due to the presence of certain muscular bands, called musculi pectinati.

At the upper part of the back wall between the two cavæ will be seen an oval depression, the fossa ovalis, which marks the situation of a communication which existed in fœtal life between the two auricles. Below this, between it and the auriculo-ventricular opening, and stretching across the cavity, are the remains of another fœtal structure, the Eustachian valve. Its condition in adult life varies from a few fibres, which are scarcely perceptible, to a well-marked and very thin reticulated valve of considerable extent.

Immediately below this valve again is the coronary sinus guarded by its valve (the valve of Thebesius).

Leading into the right ventricle is the large auriculo-ventricular valve, with its three divisions or cusps, therefore called the tricuspid.

On examining the ventricle, numerous muscular bands (musculi papillares) will be seen attached to its walls, so as to strengthen them.

These are of three kinds: those which are attached to the walls along their whole length, those which are attached merely by their two ends, and, lastly, those which are attached by one end to the ventricle wall, and by the other to the tendinous cords (chordæ tendineæ) of the valves.

The three semilunar valves at the commencement of the pulmonary artery should be examined.

The left ventricle presents much the same appearance as the right, except that its walls are much thicker, and that the opening by which it communicates with the left auricle is guarded by a bicuspid (mitral) valve.

The orifice of the aorta, like that of the pulmonary artery, is guarded by three semilunar valves.

The **relations of the great blood-vessels.**—The relations of the ascending, transverse, and descending portions of the aorta, must now be carefully studied. The aorta, it will be observed, passes up in *front* of the root of the right lung, and descends *behind* the root of the left lung, whilst the transverse portion goes obliquely backwards.

Its relations to the trachea and œsophagus must be re-studied, and likewise to the cardiac plexuses.

From the arch, at its highest point, is seen to be given off the innominate artery, which will be seen to divide behind the right sterno-clavicular articulation into the carotid and subclavian, whilst, to the left of the innominate artery, the subclavian and carotid are

given off as two separate branches direct from the aorta. The student will not fail to note that, owing to the oblique direction of the transverse part of the aortic arch, the subclavian lies almost directly behind the carotid. It should be observed that the great trunks which arise from the aorta are crossed by the left innominate vein, and that the innominate artery crosses the trachea obliquely. There is a small nerve on the innominate artery (cardiac branch of vagus).

Winding round the subclavian artery of the right side, the right recurrent laryngeal nerve will be found.

In the roots of the lungs, which should now be completed, will be found the bronchial arteries (nutrient arteries of the lung), which are various in origin, and may be traced back either to the aorta or to an aortic intercostal.

The relationship of the pulmonary vein and artery, and of the bronchus from above downwards, and from before backwards in the roots of the lungs, will next be made out, and committed to memory.

During the course of the dissection of the middle and posterior mediastina it is impossible that the veins should not have been touched. There will, therefore, probably be little need for dissection to display the vena cava superior, with its tributaries the two innominate veins. The relations of all these veins must be studied, and the small branches which enter them made out, and verified from some text-book of descriptive anatomy.

When all the various structures in the thorax have been once more gone over by the student, so as to ascertain that he knows them, the heart, with the pericardium, should be removed from the chest, by cutting through the various vessels just outside the heart, and removing that part of the diaphragm to which the pericardium is attached.

By stuffing the pericardium with tow, and sewing

up the cut which was made in it to display the heart, the student will probably be able to dissect out the reflections by which the vessels are covered, and so ascertain which are completely invested by pericardium.

It is best to begin with the aorta and pulmonary artery, and then to pass on to the venæ cavæ and pulmonary veins.

The student will do well to bear in mind, that though it is possible to make a dissection of the heart in an ordinary dissecting-room body, such dissection should at least be supplemented by the dissection of the fresh heart of a pig or sheep, or, better still, if he can obtain one, of the fresh human heart.

The **lower aperture of the thorax,** with the structures that pierce the diaphragm, will now be easy to get at.

The diaphragm will have been somewhat destroyed by this time, if the abdomen has been dissected, but all the most important parts remain. It must be put on the stretch as far as possible, and its upper surface cleaned, taking care not to cut away any of the structures which have already been seen to pierce it.

Its shape (that of a dome) will need to be carefully observed. As its edges are firmly fixed to the side of the chest, the student will readily understand that the contraction of its muscular fibres causes them to become flattened, and so enlarge the cavity of the chest, thus sucking in at each inspiration both air into the lungs and blood into the heart.

An incision may now be made from the front backwards, so as to expose the contents of the muscular œsophageal opening. The liver has presumably been removed by this time, but the stomach remains still *in situ.* (*Vide* Dissection of abdomen, page 163.)

By the assistance of the dissector of the abdomen, the relations of the œsophagus and stomach throughout their whole extent should be carefully re-studied, and the vagi traced to their destinations on the back and front of the stomach. The student will not fail to notice that the œsophagus pierces the diaphragm at the level of the ninth dorsal vertebra, almost an inch to the left of the middle line of the body.

The aortic opening will now need to be laid open in a similar fashion. It is seen to be lower down, as the aorta emerges into the abdomen, between the crura of the diaphragm at about the level of the twelfth dorsal vertebra.

The thoracic duct, vena azygos major, and sometimes the left sympathetic nerve, will be seen to traverse the same aperture, and must be traced onward to their destinations. (*Vide* Dissection of abdomen, page 172.)

The right and left crura of the diaphragm must be cut away, so as to trace onward the splanchnic nerves, and vena azygos minor, into the abdomen.

N.B.—During the dissection of the diaphragm the phrenic nerves can usually be traced through it, that on the right side communicating with a small ganglion derived from the solar plexus, which is called the ganglion diaphragmaticum.

The **upper aperture of the thorax** must now be carefully studied, so as to make out what are the relations of the structures that enter it from the head and neck. It is doubly necessary to draw attention to this, for, as it is difficult to say whether it belongs to the head and neck or to the thorax, it is in considerable danger of being neglected altogether.

The best way to learn the contents of the upper aperture is to bear in mind that the contents of the thorax extend upwards for some little distance above the edges of the bony opening.

The two pleuræ, with the lungs inside them, have been already stated to pass out of the thorax above, when their surface marking was studied; the extent to which they do so can be made out if the student pushes his fingers into the apices of the pleuræ.

On the skeleton, a line drawn on each side, from the costo-vertebral to the costo-sternal articulation of the first rib, will mark with fair accuracy the inner edges of the two pleuræ, the spaces in between them being devoted to the œsophagus, trachea, blood-vessels and nerves. After these general considerations have been mastered, the boundaries and the positions of the parts which pass through the space should be clearly made out. If it has not been done, the ligaments which compose the sterno-clavicular articulation should be dissected. This articulation is usually dissected with the arm. Whoever dissects it should remember to examine the bones and cartilages which enter into its formation, and the ligaments which bound it externally; and when this has been done, an incision should be made into its capsule to see the fibro-cartilage which it contains. When this has been accomplished, the sternal end of the clavicle, with the sterno-mastoid and sterno-hyoid muscles, should be separated and turned upwards. The superior aperture of the thorax is bounded behind by the first dorsal vertebræ, at each side by the first rib and costal cartilage, and in front by the sternum. The structures, in detail, which it transmits are:

Ligaments:
  Anterior common of spine.
Muscles:
  Longus colli.
  Sterno-hyoid.
  Sterno-thyroid.
Arteries:
  Innominate.
  Left subclavian.

Arteries:
  Left common carotid.
  Both internal mammaries.
  Both superior intercostals.
  Thyroidea ima (sometimes).
Veins:
  Right and left innominates.
  Inferior thyroid veins.

Nerves:	Nerves:
Both vagi.	First dorsal nerve on both sides.
Right recurrent laryngeal.	Trachea.
Both phrenics.	Œsophagus.
Sympathetics.	Thoracic duct.
Cardiac nerves.	Apices of lungs and pleuræ.
	Remains of thymus gland.

All of these parts require to be dissected, but as nearly all of them have been found either in the thorax or higher up in the neck, they merely require to be followed upwards and downwards, and their relative positions determined. A proper knowledge of their relations is most important. The accompanying diagram may assist the student in gaining a proper idea (Fig. 28). The sterno-hyoid and sterno-thyroid muscles are to be cleaned, and then divided and turned upwards and downwards. The great veins lie anterior to the great arteries. They are to be dissected in turn. The pneumo-gastric (vagus) and phrenic and cardiac nerves may then be followed between the subclavian artery and veins. The first and second portions of the subclavian arteries and their branches are most conveniently dissected along with the upper aperture. Their relations and branches are to be accurately noted. The vertebral arteries and veins can be followed to their entrance into the vertebral canals; as this is being done, another artery, the inferior thyroid, and its accompanying vein and right recurrent laryngeal nerve, are again met with. The artery and vein may be traced to the thyroid axis and subclavian veins respectively, and the nerve to the pneumo-gastric. The thyroid axis is given off from the subclavian just before it passes under the scalenus anticus. Two of its branches, transversalis colli and suprascapular, have been dissected in the posterior triangle. They may now be completed. The internal mammary artery should be

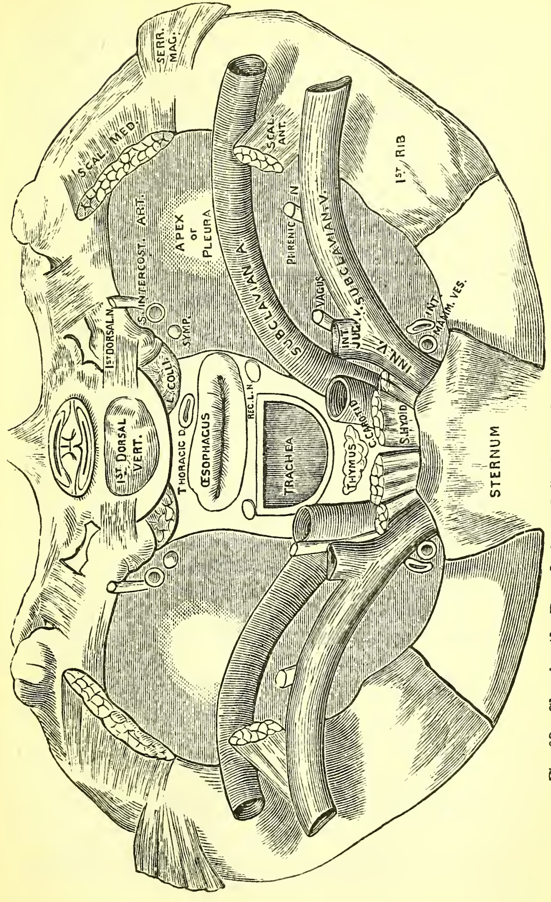


Fig. 28.—Showing the Boundaries and Contents of the Upper Aperture of the Thorax.

looked for coming from the subclavian close to it. The phrenic nerve crosses the internal mammary at its origin, and may be used as a guide to the artery.

All of these branches, vertebral, internal mammary, and thyroid axis, come from the subclavians in the first part of their course, which is internal to the scalenus anticus.

The second part of the subclavian lies behind the scalenus anticus. Only one branch, the superior intercostal, is given off at this point. This artery, after arising from the subclavian, lies in front of the neck of the first rib, along with the first dorsal nerve and the first dorsal ganglion of the sympathetic.* If the thorax be well tilted, so that the student can look upwards into the dome of the pleura, these structures can be seen without any dissection, but to expose them the pleura should be removed. The sympathetic may be traced down to where it has already been dissected, and the intercostal artery cleaned where it lies, in the first and second intercostal spaces. As it crosses the neck of the first rib it gives off a branch (profunda cervicis), which will be afterwards traced to the back of the neck. The first dorsal nerve should be dissected and cleaned as it passes upwards behind the subclavian artery, where it has been already seen. It gives off a most important and greatly-overlooked branch, first intercostal, as it lies upon the neck of the rib. This branch can be seen, before the pleura is removed, running between that membrane and the under surface of the first rib, which it grooves. It does not really become an intercostal nerve until it has almost got as far forward as the front of the intercostal space, where it pierces and supplies the intercostal muscles and becomes cutaneous. The innominate artery, as it lies in front of the trachea,

* The last cervical and first dorsal ganglion are usually joined, and lie in front of the neck of the first rib.

frequently gives off a branch which runs up in front of the tube to the thyroid body. It should be sought for amongst a quantity of connective tissue, which is usually present, and represents the remains of the thymus gland. In the same tissue a number of veins (inferior thyroid) descend from the thyroid body to open into the innominate veins. The trachea, and œsophagus, and thoracic duct should be carefully examined, to ascertain their relative positions. The thoracic duct should be searched for, ascending from the thorax, deep down between the left subclavian and left common carotid arteries. Its walls have about the same thickness as a small vein, with which it might easily be confused were it not for its white colour. When it has been discovered its course should be followed, arching above the left subclavian artery, and forming a similar curve, until it passes beneath the internal jugular vein, and over the scalenus anticus, to open into the junction of the subclavian and internal jugular veins. In doing this portion of the dissection the jugular vein requires to be pulled away from the carotid, and care should be taken not to injure the left vertebral vein, or the great nerves which the thoracic duct is in relation with, as it makes its arch.

Before leaving the upper aperture the student should take the opportunity to review the subclavian arteries as a whole, and accurately determine what would require to be removed to expose them.

CHAPTER VII.

DISSECTION OF THE HEAD AND NECK.

It is desirable that the dissection of the head and neck should begin at the scalp, for until this is

accomplished it is not possible to remove the brain. To obtain a brain in the best possible state it is absolutely necessary to remove it at once, and place it in a proper hardening solution.

Instead of doing this, another method may be adopted, which has the advantage that it hardens beautifully all the nerves at the base of the brain and preserves the spinal cord. This is a most important point, as unless the following plan* be carried out a good spinal cord is never seen in the dissecting-room. Obtain a vessel which will contain about a pint and a half (an old teapot answers very well); an indiarubber tube, about twelve feet long; and a strong glass or metal tube, about six inches long and a quarter of an inch in diameter. A block having been placed under the neck, a hole should be drilled through the skull in the following manner: Make a crucial incision down to the bone, about three-quarters of an inch above the centre of the orbit. With a drill make an aperture a quarter of an inch in diameter through the skull, and with a long thin knife continue it through the membranes. The metal or glass tube, as the case may be, should now be pushed into the brain until it is estimated to have gone in horizontally as far as the external auditory meatus. When it has been fixed in position a wire should be passed into it to clear its end, which, if possible, should reach the lateral ventricle of the brain, and the elastic tube can then be fitted on. The teapot should next be filled with spirit, and the other end of the tube fastened to its spout. The last thing now remains to be done, which is to elevate the vessel and tube to a height of about ten feet. Left for a day or two (the longer the better), the spirit gradually finds its way through the whole of the spinal

* This method is used by Mr. Cook, who kindly showed it to the writer.

canal and brain cavity. Whilst the injection of the brain with spirit is going on, the dissection of the scalp may be begun. At most medical schools the student does not have a whole head and neck to himself; he divides it with a friend. They must therefore arrange their times for work, so that they shall not interfere with one another. A very good arrangement is for one to read some manual of dissection whilst the other dissects. Presuming, of course, that the scalp has been shaved and a block placed under the head, the following incisions should be made through the skin only: One round the head from just above the eyebrows to the external occipital protuberance, and a second starting from the occipital protuberance over the top of the head to join the other in front. The student should begin to remove the skin in front, near the root of the nose, by dissecting up one of the corners of the flap. Keeping very close to the surface, the integument should be taken off in one clean, thin layer. Owing to the presence of many hair-bulbs, the dissection of the scalp will be found to blunt the knives very easily. Beneath the skin is a firm and tough layer of subcutaneous tissue, consisting of fat, blood-vessels, nerves, and hair-bulbs. The parts which are to be dissected are the

Upper part of orbicularis oculi and corrugator supercilii.
Occipito-frontalis.
Muscles of ear.
Nerves:
- Supratrochlear.
- Supraorbital.
- Lachrymal.
- Temporo-malar.
- Auriculo-temporal.
- Posterior auricular.
- Lesser occipital.
- Great occipital.

Arteries:
- Frontal.
- Supraorbital.
- Temporal.
- Posterior auricular.
- Occipital.

The arteries, being injected, will not be difficult to find, and will serve as guides to the nerves which

generally accompany them. It is to be observed that all the vessels and nerves run from the circumference towards the vertex of the skull. All incisions, whether made by the dissector or surgeon, should take a corresponding direction. The nerves of the scalp will be found much more difficult to discover than the arteries. The accompanying diagram (Fig. 29) may aid in showing their positions. Those in front, the supratrochlear, the supraorbital and twigs of the lachrymal,

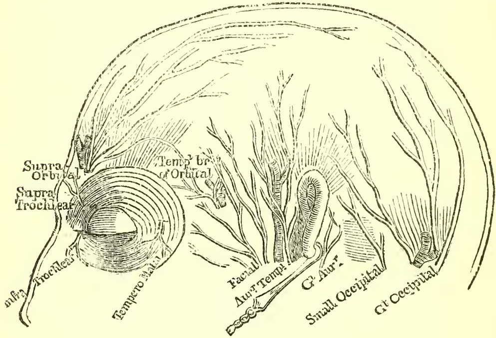


Fig. 29.—Nerve-supply of the Scalp.

emerge from the orbit between the muscles, orbicularis palpebrarum and occipito-frontalis, and the bones. To find them it is best to make an incision through the orbicularis parallel to the margin of the orbit, seeking carefully for the nerves, which are very liable to be divided by an incision over their course. The supraorbital is easiest to find, as the notch in frontal bone, through which it emerges, may be sought for. When discovered, the nerves should be traced up as far as possible. They are very thin and delicate, so that no traction should be made upon them, and only their

connective-tissue surroundings touched. The other nerves should be carefully sought for in the following places: The temporal branch of the temporo-malar nerve will be found about an inch above the zygoma, and an inch behind the external angle of the frontal bone. It lies at first beneath the orbicularis palpebrarum, crossing almost parallel to the margin of the orbit, and not, like the other cutaneous nerves, towards the vertex of the scalp. The temporal fascia should next be cleaned. Usually an aperture can be discovered, giving passage to the small temporo-malar nerve. The auriculo-temporal branch of the fifth must be found behind and beneath the temporal artery. It will be found best to begin the dissection for finding it, near the tubercle of the zygoma. The posterior auricular branch of the facial is found running with the corresponding artery beneath the retrahens aurem muscle. The lesser occipital runs up the scalp exactly at the posterior border of the sterno-mastoid. The great occipital nerve is close to the occipital artery, and lies midway between the occipital protuberance and the mastoid process. The suboccipital and posterior branch of the third cervical nerve sometimes supply the scalp, but are seldom made out.

Muscles of scalp.—The chief muscle of this region is the occipito-frontalis; it belongs to the same order of muscles as the platysma. The dissection should be begun in front by completely cleaning the upper fibres of the orbicularis palpebrarum. The frontalis will be found blending with them. The central fibres of the frontalis may afterwards be traced down the nose, going to form the pyramidalis nasi. If the upper border of the orbicularis oculi be dissected from the skull, a few muscular fibres can be traced, from an attachment to the frontal bone, radiating outwards into the orbicularis; this is the corrugator supercilii. The fat and subcutaneous tissue of the scalp being gradually

removed, the tendon or aponeurosis of the occipito-frontalis comes into view. This is generally called the cranial aponeurosis. Traced backwards, the cranial aponeurosis will be found to end in a fleshy belly, the occipitalis. Separate the aponeuroses in the middle line, and pass the handle of the knife into the cellular interval between it and the pericranium, or periosteum of the skull. It may be noticed how freely the aponeurosis can glide on the pericranium.

Extrinsic muscles of the ear are: (1) The attolens aurem, (2) attrahens aurem, (3) retrahens aurem. The skin and subcutaneous tissue are next to be removed from these small muscles. To do this, make a circular incision through the skin of the pinna, about where it meets the side of the head. Then pull the ear forwards with hooks, and put the retrahens aurem, which lies behind the ear, upon the stretch. Clean it carefully, and make out the posterior auricular nerve and artery passing beneath it. The fibres of this and the following muscles are so pale that great care must be taken not to remove them. The attolens (just above the ear) and attrahens (in front of ear) are to be dissected in a similar manner. A few muscular fibres can be seen upon the pinna of the ear, and senior students should endeavour to make them out and learn them.

Temporal muscle.—The muscles of the ear having been dissected, the white glistening temporal fascia, which starts from just behind the zygoma, must be removed. An attempt should be made to find its two layers. An incision should be made above and parallel with the zygoma. One layer of the fascia is attached to the outer margin of this process, the other to the inner, so that there is the greatest interval at this point. The temporal branch of the temporo-malar nerve, which pierces the temporal fascia about an inch above the zygoma, and about the same distance

behind the orbit, should be sought for between its layers; the orbital branch of the temporal artery is near the nerve, but is sometimes absent. Having removed the temporal fascia, clean the muscle beneath it as far down as is possible.

Removal of the skull-cap.—In order to remove the brain, the skull-cap is next to be taken off. With a strong knife divide firmly all the structures down to the bone which are crossed, by a circular incision drawn an inch above the external angle of the frontal bone, the pinna of the ears and mastoid process, as far back as the external occipital protuberance. The student should obtain a rough cloth to place over the cranium. It is not easy to steady the skull for sawing, with the naked hand. A strong and sharp saw should be procured, and a hammer and chisel. The latter should be made with a cross-bar, to enable it to be used as a wrench (Fig. 30). The outer table of the skull should be sawn through. It may be known when this is accomplished by the red moist sawdust which comes from the diploe. As the diploe contains blood-vessels, in the case of the living subject blood would be seen when the diploe was reached. The amount of diploe to be sawn through varies greatly in different skulls. In children it is absent; it becomes more abundant as age advances. The greatest care should now be taken in sawing through the inner table. The saw may be applied very freely over the angular processes of the frontal bone, and at the occipital protuberance. In other parts the greatest

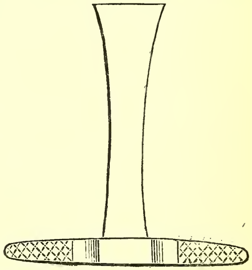


Fig. 30.—Wrench or Elevator.

care must be observed, or the brain will be lacerated. When there is good reason to suppose that the greater part of the inner table is sawn through, probing with a piece of wood or quill toothpick will assist in arriving at a correct conclusion. The chisel and hammer should be applied very carefully to the parts which do not appear to yield. Give the chisel an occasional wrench to loosen the skull-cap. This sometimes requires considerable force, especially in old people, as in them the dura mater becomes so much more adherent to the inside of the skull. If, as sometimes happens, it be found impossible to take off the vault of the skull without tearing the dura mater from the base, it will be safer to divide the dura mater all round with a knife, and remove the upper part of it along with the bone. If the skull-cap only has been removed, the dura mater will be seen covering the brain. Before it is removed, the following structures should be examined: The interior of the skull-cap, in order to see the sutures, depressions for Pacchionian bodies, and grooves for the middle meningeal arteries and superior longitudinal sinus. The structures themselves will be seen upon the dura mater.

The dura mater sends strong septu, or partitions, between the great lobes of the brain. The dura mater consists of an outer and an inner layer. When a partition is formed the outer layer remains upon the bone, the inner layer doubles in to form the partition.

At the place where the doubling in occurs an aperture is left. This is the sinus. Therefore the layers of the dura mater separate to form the sinuses. At this stage, only the superior longitudinal sinus can be seen. The remaining sinuses must be examined when the brain has been removed.

To expose the superior longitudinal sinuses the student should enter the point of the scissors or knife

in the middle line, and run it forwards and backwards. When the structures contained in the sinus have been made out (cords of Willis, openings of cerebral veins, and Pacchionian bodies) the dura mater should be divided all round on a level with the incision through the bones. To effect this a knife or scissors should be pushed into the subdural (or arachnoid) cavity, and an incision made round each side, but not completed behind, where the superior longitudinal sinus and falx cerebi, or process of dura mater which separate

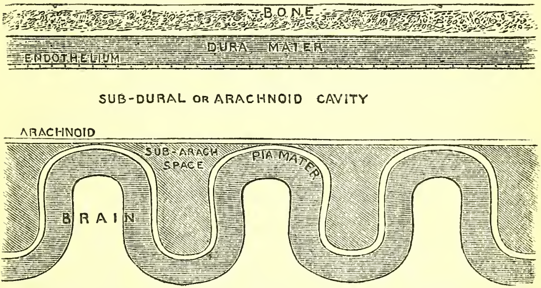


Fig. 31. — Diagram showing the Subdural (arachnoid) and Subarachnoid spaces and Membranes of the Brain.

the two halves of the brain, are to be left intact. In front the knife must be passed a little way, from before backwards, into the great fissure between the cerebral hemisphere and the front of the falx, separated from the crista Galli. By the arachnoid space is meant the cavity between the dura mater and the cerebral layer of the arachnoid. Soon the subarachnoid space will be mentioned. It will be found to be the space between the arachnoid and pia mater. It contains a variable amount of fluid, which lifts up the arachnoid from the surface of the brain. This is very readily seen in a fresh subject, as it contains fluid, but is not

clearly distinguishable in those which have been preserved for dissection.

The student will do well to remember that some authors describe the arachnoid as a serous membrane of two layers, a visceral and parietal. The parietal layer is simply a layer of endothelium, which, in this description, is supposed to belong to the dura mater.

When the dura mater and falx cerebri have been divided, they should be drawn backwards, and the hemispheres of the brain exposed. In doing this a member of the superior cerebral veins, which empty into the superior longitudinal sinus, will have to be torn through.

CHAPTER VIII.

REMOVAL OF THE BRAIN.

If the brain has been treated with spirit, as was recommended at first, it will be by no means difficult to remove it without injuring the nerves at the base of the skull. The student should endeavour to remove the whole brain without lacerating it, and to cut the cranial nerves in such a manner as to leave a part of them attached to the brain to show their point of origin, and a portion at their place of exit from the dura mater. It must be noted that some of the cranial nerves pierce the dura mater a little distance from their point of exit from the skull. The left hand should be placed behind and on the top of the brain, to support it; a block having previously been placed beneath the occiput, the fingers of the right hand should gently lift the frontal lobes from the anterior fossa of the skull. The olfactory lobes, which rest on the cribriform plate, being covered with arachnoid,

are lifted up with the brain; their branches are too delicate to hold the lobes down. As the student continues to draw the brain backwards and support it behind, the optic nerve comes into view. This must be divided with a long, thin, and very sharp knife, cutting downwards on the skull. The internal carotid artery is next divided, and afterwards the third nerve. When this has been accomplished the pituitary body must be removed from its fossa. To do this, push the point of the knife into the fossa all round the margin of the gland, and then with the handle of the knife turn it out, leaving it in connection with the brain by means of a delicate process, the infundibulum. It may be as well to remember that the circular incision opens the circular sinus. At this stage it will be found impossible to draw the brain farther back, owing to the way in which the cerebellum is held down beneath the tentorium cerebelli. This structure will readily be distinguished, as a process of dura mater stretching from the ridge of the petrous portion of the temporal bone underneath the posterior lobe of the brain, and separating it from the cerebellum. In order to divide it, push the point of the knife against its inner edge, close to the posterior clinoid process, and cut outwards along the margin of the petrous portion of the temporal bone. This incision should be continued as far outwards and backwards on each side as is possible. The fourth nerve will be divided just beneath the inner edge of the tentorium, where it lies concealed, and may be readily seen by everting the margin. Continuing to draw the brain backwards, the remaining cranial nerves should be divided in their turn: the fifth nerve where it lies upon the apex of the petrous bone; the sixth, in front of the basilar process of the occipital bone (here it runs forward at the side of the basilar artery, and may be seen piercing the dura mater nearly an inch behind the

groove on the posterior clinoid process); the seventh pair of nerves is farther out, entering the internal auditory meatus. The auditory artery, a branch of the basilar, enters with the nerves, and will aid in distinguishing them. The artery requires to be cut through as well as the nerves. At the lower and back border of the petrous bone the eighth pair of nerves come into view. The student is not able to distinguish each division (pneumogastric, glosso-pharyngeal, and spinal accessory) separately, but the spinal portion of the latter nerve can be seen coming up through the foramen magnum, and will serve as a guide to the other nerves. A bony eminence (the eminentia innominata) at each side of the foramen magnum has beneath it the ninth nerve, hypoglossal. Observe that this nerve leaves the dura mater in two bundles, which are separated by about a quarter of an inch of the membrane. The tips of the fingers should next be placed beneath the front of the cerebellum, so that the medulla oblongata, which connects the brain with the spinal cord, is between the ring and middle finger.

The last step of the operation remains. This is to divide the vertebral arteries and medulla oblongata. No difficulty will be experienced in dividing the first. To divide the latter, hold the knife as near the handle end as possible, push it into the foramen magnum by the side of the medulla, and cut it across just below the foramen. Nothing now remains but to remove the brain, and place it in a suitable hardening medium.

Hardening the brain.—Before placing the brain in a hardening solution, it is necessary to remove the pia mater, which is the vascular membrane covering the surface of the organ. Unless the pia mater be carefully removed, the spirit will fail to harden the brain efficiently. To remove the membrane will, of course, entail the destruction of the

circle of Willis (which is the circle at the base of the brain formed by the carotid and vertebral arteries) and the great trunks which go from it to the brain. It is therefore desirable to learn these first. Place the brain, base upwards, upon a clean board, and wind a cloth round it in such a way as to prevent it collapsing. The circle of Willis will be found between the two protruding lobes called temporo-sphenoidal. When these lobes are pulled on one side the arteries still remain concealed by the arachnoid, which in this situation is very loose. With two pairs of forceps the membrane should be pulled away, and the lobes of the brain gently separated with the tips of the fingers, in order to display the great trunks as they pass from the circle. As this is done, more arachnoid will require to be removed, and when the arteries have been properly displayed and learnt, the student may begin to remove the pia mater. In doing this the two pairs of forceps come into requisition again, and the greatest care must be taken not to drag the nerves away from their attachments to the brain.

If the arteries or veins threaten to lacerate the convolutions when they are being removed, divide them with scissors. Do not omit to note that the pia mater dips down in between the convolutions.

When the under surface has been cleaned, carefully turn the brain over and complete the vertex. Take care to draw the pia mater out of the sulci, and pass the handle of the knife between the posterior extremity of the corpus callosum, in order to admit the hardening solution into the interior. The corpus callosum is the great transverse commissure or connection which unites the two halves of the brain, and may easily be seen by slightly separating the two halves.

Some soft clean tow having been obtained, a nest should be made for the brain in a suitable earthen

basin or jar. The hardening solution may then be added. The one commonly in use is spirits of wine. Not less than a pint and a half of methylated spirit should be poured over the brain, and the jar carefully covered to prevent evaporation.* In about five days the brain should be examined, turned over, and fresh strong (60 over proof) spirits added. In about fourteen days the brain is ready for use, or it may be kept until required. The way in which it has to be dissected will be described afterwards. Many other methods of hardening brains are in use. Nitric acid is a cheap and efficient hardener. If this method be employed, some strong nitric acid should be mixed with water in the proportion of 1 to 12, and the brain left in the solution for about a week. Afterwards the brain should be taken out of the acid, and kept in weak spirit and water. If left too long in the acid the brain shrinks, and becomes so hard that the most important parts cannot be made out. Before proceeding with the interior of the skull, the face and neck should be covered with a damp cloth and a layer of guttapercha tissue.

CHAPTER IX.

DISSECTION OF THE INTERIOR OF THE SKULL AFTER THE BRAIN HAS BEEN REMOVED.

THIS comprises the sinuses, arteries, and nerves. The falx cerebri and tentorium cerebelli should be stretched in position, in order to see the relation they have to the skull. When this has been done, the following sinuses require to be examined. The student is

* If a hydrometer be employed, the exact strength should be 10 to 15 over proof.

recommended to mark the proper position of each upon the skull which he has by him for reference.

Superior longitudinal.	Cavernous.
Inferior longitudinal.	Circular.
Straight sinus.	Superior and inferior petrosal.
Lateral sinuses.	Transverse.
Occipital sinuses.	

The superior longitudinal sinus has already been opened and its contents displayed. A fine pair of scissors should be inserted into the inferior longitudinal sinus, which is situated at the lower border of the falx, just before this sinus joins the straight, and the canal opened from behind forwards. This incision may be continued backwards along one side of the junction of the tentorium cerebelli and falx cerebri, in order to open the straight sinus, which joins the inferior longitudinal with the torcular Herophilii. With a knife the lateral, petrosal, and occipital sinuses may be opened. The small transverse sinus joins the two inferior petrosal sinuses together, and crosses the basilar process a little behind where the sixth nerve pierces the dura mater. To find the sinus the dura mater should be probed with the point of the knife until the hollow of the sinus is felt. The circular sinus was destroyed in taking out the pituitary body; to display it properly a special dissection would be required. The small circular canal may be filled with injection from the cavernous sinus; a skull in which the pituitary body has not been removed should be chosen. The posterior clinoid processes having been removed with the bone forceps, the back part of the sinus comes into view. The front part may be seen by tracing the sinus round the pituitary body. The dissection of the cavernous sinus is very important, and before commencing it the small meningeal arteries should be sought for, and the remaining nerves displayed.

The meningeal arteries in the anterior fossa are very small, and may be seen close to the cribriform plate. They come from the ethmoidal branches of the ophthalmic. The most anterior one serves as a guide to the nasal nerve, which at this point crosses the cribriform plate, to disappear down the slit (nasal) by the side of the crista galli. The dura mater should be removed by transverse cuts in order to display this nerve, of which only about an eighth of an inch can be seen.

The most important artery in the middle fossa is the middle meningeal. In cleaning it care should be taken not to remove its accompanying veins. The branch which it sends forward to the orbit is easily seen, and another may be made out running backwards and outwards to enter the petrous bone through the hiatus Fallopii. If another delicate artery is seen accompanying the petrosal branch of the middle meningeal it is a branch of the Vidian, which enters the ear by the same apertures. These arterial twigs, which are often small and uninjected, serve as guides to the great petrosal nerve, which may now be very carefully traced from the hiatus Fallopii, until it passes beneath the gasserian ganglion. Great care must be taken not to mistake fine bundles of dura mater for this nerve. Sometimes the small and external petrosal nerves can be found a little external to the greater, but much depends upon the way in which they happen to leave the petrous bone. (*Vide* page 331.)

In the posterior fossa of the skull some small meningeal arteries *may* be seen entering at the jugular foramen and anterior condyloid foramena, but no special directions are required for their dissection. The meningeal branch of the vertebral arteries is of larger size and easily distinguished.

The nerves in the posterior fossa of the skull

should be recognised, but at present require no dissection. The dissection of the cavernous sinus may be begun, and afterwards the nerves contained in its walls traced onwards into the orbit.

Dissection of the cavernous sinus.—Before beginning the dissection, the student should obtain a skull, and make out the following landmarks: The sphenoidal fissure, anterior clinoid processes, posterior clinoid processes, carotid groove, groove for sixth nerve, depression for Casserian ganglion, foramen ovale, and foramen rotundum. It may be observed

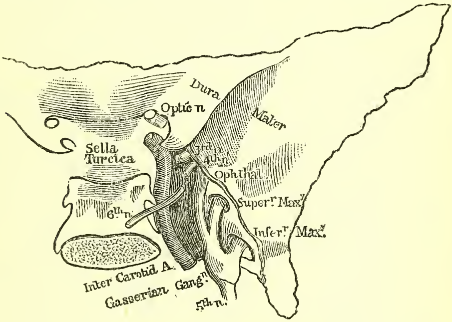


Fig. 32.—Cavernous Sinus.

that this latter foramen is immediately beneath the anterior clinoid process. When these points have been distinguished, a piece of paper may be placed in the middle fossa, so as to touch the clinoid processes internally, and the greater wing of the sphenoid, near the foramen rotundum below. The space between the paper and the clinoid processes represents the cavernous sinus. In the dura mater, which forms its outer wall, the third, fourth, and ophthalmic divisions of the fifth nerve lie in order from above downwards. The

carotid artery lies in the sinus, close to the posterior clinoid process, and in close contact with it is the sixth nerve. The student should endeavour to see whether the artery is bathed in the blood of the sinus or not. Surrounding the carotid artery, in a close meshwork, is the sympathetic. The dissection should be begun with the third nerve, which must be traced as far as the sphenoidal fissure. The fourth nerve lies very close to it, and may be traced forwards from beneath the margin of the tentorium cerebelli; when it has been found, care must be taken not to pull upon it with the forceps : being very thin and delicate, it is easily broken. Upon a fresh and good subject, the fourth nerve may be seen to give off a small recurrent branch to the dura mater (Bidder's nerve), and nearly always it will be found to form very extensive communications with the fifth. The dura mater, which crosses the Casserian ganglion, may now be removed. Care must be taken to keep close to its under surface, or the fibres of the fifth will be removed with it. The three divisions of the ganglion are to be traced into the sphenoidal fissure, foramen rotundum, and foramen ovale, respectively. The nerve and ganglion may next be lifted up to display the motor root which lies underneath, and which may be distinguished by its whiter and firmer appearance. The student is recommended not to do too much dissecting at the ophthalmic division of the fifth, but to leave it until he has begun the orbit. The small meningeal artery may sometimes be seen near the inferior division, entering the skull by the foramen ovale. The sixth nerve should next be found, as it pierces the dura mater over the basilar process. The membrane over it should be cut through until the nerve is found upon the carotid artery. It should be traced forwards towards the outer wall of the sinus, until it is lost beneath the ophthalmic division of the fifth. Nothing

remains to be done, except to clean the carotid and make out the ophthalmic artery coming from it. Small bands may have been observed crossing the cavernous sinus; they divide it up into little recesses or caverns, hence its name "cavernous." Nothing has been said about any of the venous trunks which enter the sinus. Owing to the removal of the brain, many of them have been destroyed, but soon the ophthalmic vein will be seen entering its front part.

Dissection of the orbit.—The dissection of the orbit may now be proceeded with. A pair of bone forceps and a small saw are required to accomplish this.

A Hey's saw is the one usually used. The accompanying diagram will serve to show what it is like. The frontal bone and roof of the orbit should be sawn through in the following manner: The first incision should extend from just internal to the external angular process of the frontal bone into the outer part of the sphenoidal fissure; the second incision from the inner angle of the orbit to just in front, and internal to the optic foramen. The posterior ends

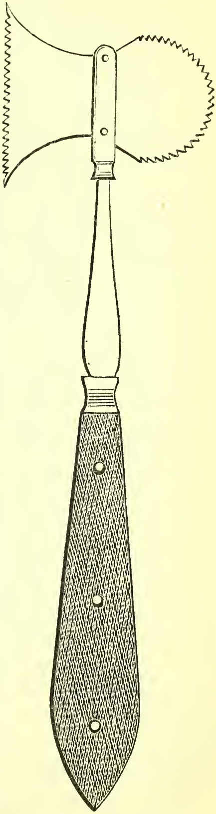


Fig. 33.—Hey's Saw.

of these incisions are to be joined. With a mallet or hammer the orbital process of the frontal bone should be knocked forward. The roof of the orbit may be displaced with it, but usually requires to be removed with the bone forceps. The chief object in displacing the orbital process of frontal bone forwards in this manner is to preserve the pulley of the superior oblique. It is usual at this stage of the dissection to inflate the eye-ball. To do this, a blow-pipe (*vide* Fig. 6) must be forcibly pushed along the centre of the optic nerve. Considerable force is required to push it through the sclerotic (lamina cribrosa) into the globe. When it has been felt to enter the vitreous chamber, a wire must be passed along to clear its canal, and then the globe may be inflated. A ligature should be placed round the nerve as the blow-pipe is withdrawn, and the air retained. The most difficult part of the dissection is now met with. Before endeavouring to make out the various structures, the student is strongly advised to make himself familiar with their relations. The diagrams contained in his anatomical text-books should be consulted, and, if possible, a dissected specimen carefully examined. The presence of a large quantity of fine fat obscures the nerves, arteries, and veins. As soon as the orbit is opened, it will be seen that all the important parts are contained within a bag of fairly strong fascia, which lines the cavity. This is the orbital fascia, and its upper part requires removal. When this has been done, the following structures require dissection .

The muscles which move the eye and eyelid.
The fourth nerve.
Fifth nerve.
Third nerve.
Ophthalmic ganglion.
Sixth nerve.
Ophthalmic vein.
Ophthalmic artery and its branches.
The lachrymal gland.

The arteries, being injected, are not in so much

danger of removal as the small nerves, which, being very much the colour of the fat and fibrous tissue, are to be sought for with great caution. It is to be observed that, with the exception of the frontal nerve with its supratrochlear and supraorbital branches, the lachrymal and fourth nerve, all the other nerves of the orbit lie upon the inner or ocular side of the muscles, and will be in no danger until the inner surfaces of the muscles are reached. The fourth nerve, owing to its small size and superficial position, is oftenest cut away; it should therefore be sought for as soon as the fascia of the orbit has been removed. It may either be traced forwards through the sphenoidal fissure from the cavernous sinus, where it has already been seen, or sought for lying upon the superior oblique. It lies very close to the muscle, and might easily be mistaken for some of its fibres or a bit of its sheath. The frontal nerve presents no difficulties, and its supratrochlear branch is easy to trace over the pulley of the superior oblique muscle, which will be mentioned presently. The lachrymal nerve lies close to the inner edge of the external rectus muscle, and if not easily brought into view, the small artery seen running towards the outer angle of the orbit (the lachrymal artery) may be found, and will serve as a guide; the nerve and artery lie close together. These nerves having been found and their safety ensured, the muscles which lie above and on either side of the eye-ball may be begun. The muscles beneath the globe can only be seen with advantage later on in the dissection. All the muscles arise close together, around the optic foramen, and run forward to their insertions. The inferior oblique is the only exception. Lying beneath the frontal nerve, and above the globe, two muscles require cleaning; they are the levator palpebræ and the superior rectus. The first muscle

should be traced forward as far as its insertion into the tarsal cartilage, afterwards the underlying muscle got at by pulling it to one side. Only the superior border and external surface of the outer rectus muscle should at present be cleaned; and when this has been done, the muscle quite at the inner side, upon which the fourth nerve lies, may be completed. This is the superior oblique, and at the inner angle of the orbit a little fibrous loop must be found, hanging down from the frontal bone. The tendon of the muscle passes through the loop to run outward to its insertion on the globe. If the superior oblique be lifted up from its position, the internal rectus is seen, but its dissection had better be deferred until the nasal nerve has been completed. To find the nasal nerve a quantity of the orbital fat requires to be removed. The little masses of fat should be gradually picked out with the forceps, and the knife used as little as possible. Avoiding the arteries, the knife should be gently worked backwards and forwards amongst the fat, in order to loosen it. As all the nerves run from behind forward, this manœuvre is not likely to divide any of them. After the ophthalmic artery and vein have been exposed, the nasal nerve will be seen crossing the optic nerve obliquely, in company with the ophthalmic artery and vein; it must be traced between the superior oblique and internal rectus until it enters the anterior ethmoidal foramen. In order to trace it back to its origin, the superior head of the external rectus and a quantity of fibrous tissue require division. It is to be observed that all the branches of the nasal nerve are given off from its anterior border, and that therefore the knife should be used with great care in this situation. The branches of the nasal nerve which are to be found are the long root of the ciliary ganglion, two long ciliary nerves, and the infratrochlear. These branches

are to be sought for in the following positions: The infratrochlear, as the nerve passes between the superior oblique and internal rectus; the long ciliary, as it crosses the optic nerve; and the long root of the ganglion, as it enters the sphenoidal fissure. It has already been remarked that they may be found by following the anterior border of the nerve; this had better be done from behind forwards. When the long root of the ciliary ganglion has been found, it should be traced forward by taking hold of it very gently and scratching along its course very carefully with the point of the knife. Soon a small reddish mass comes into view close to the outer side of the optic nerve. This is the lenticular or ciliary ganglion. In front, the very slender short ciliary nerves emerge from it, and can be traced to the sclerotic. By lifting up the ganglion very gently with the forceps, its short root appears, and may be traced down to the inferior division of the third nerve, which may now be exposed. To find the superior division of the third nerve, the superior rectus and levator palpebræ are to be turned over towards the inner side of the orbit, and the nerve looked for in close contact with their ocular surface. The inferior division has already been found lying deep in the orbit, and may be followed backwards and forwards. The sixth nerve remains to be examined, and is to be found closely applied to the internal surface of the external rectus. If the superior attachment of the external rectus be placed in position again, it will be observed that the two divisions of the third, the nasal and sixth nerves, and ophthalmic vein, appear to pass between its upper and lower attachments, or heads, as they are called.

By this time the main trunk of the ophthalmic vein will have been exposed. It generally contains a little blood, which enables it to be recognised. It should be dissected from the sphenoidal fissure over the

optic nerve to the inner angle of the orbit. The ophthalmic artery and its branches should be dissected. No special directions are required to enable the student to do this. It can only be followed as far as the inner angle of the orbit at present, but its terminal branches, frontal and nasal, will be seen when the face is dissected. The lachrymal nerve and artery are to be followed into the lachrymal gland, which may now be cleaned. With care, the nerve and artery may be seen to pass beyond the gland into the upper eyelid. The student, having made himself quite familiar with all the structures he has found in the orbit, may now divide the levator palpebræ, superior rectus, and optic nerve, and lift the globe upwards and forwards in order to see more completely the inferior division of the third nerve and the inferior oblique muscle. The last thing which remains to be done is to look on the outer wall of the orbit, close to the bone, for a small branch of the superior maxillary nerve, the temporo-malar, which enters the orbit through the spheno-maxillary fissure. There is no particular guide to this nerve, but it may usually be seen lying on the malar bone, and when it has been found a communication between it and the lachrymal may be seen.

The orbit having been completed, the block beneath the head should be lowered, and the dissection of the ocular appendages and muscles of the face begun.

Dissection of the ocular appendages and muscles of the face.—In order to consult the convenience of those who are dissecting the arm, it is the custom in many dissecting-rooms to pass on to the dissection of the posterior triangle of the neck immediately after the brain has been removed, the orbit and face being completed afterwards. At present the appendages of the face will be gone on

with. The dissection of the face includes the following ~~regions~~ parts :-

Ocular appendages.
Nose.
Muscles of face and mouth.
Facial artery and branches.
Facial vein.
Nerves:
  Infraorbital.
  Mental.
  Nasal.
  Temporo-malar.
  Facial.
  Auriculo-parotidean.
  Forehead nerves, already seen with scalp.
Parotid region.

The skin incisions which are required are as follows: The first should extend down the middle line of the face from the superciliary ridge to the chin; a second from the chin backwards to the angle of the jaw. Incisions should be made round the margins of the eyelids, mouth, and nose. Keeping very close to the surface, the integument must be cleaned backwards over the parotid region as far as the lobule of the ear. The greatest difficulty will be met with at the eyelids. To get over this they should be stuffed with tow or wool, and the lids sewed together; the sewing can easily be undone afterwards. It will also make matters easier if the mouth and nose be well filled with tow and the lips sewed together.

Dissection of eyelids and appendages.—The structures met with in this region are the

Orbicularis oculi muscle.
Tensor tarsi muscle.
Tarsal cartilages and ligaments.
Conjunctiva.
Caruncula lachrymalis.
Plica semilunaris.
Papilla lachrymalia.
Puncta lachrymalia.
Canaliculi.
Lachrymal sac.
Meibomian glands.
Blood-vessels and nerves.

Before fastening the eyelids together, the small red elevation at the inner end of the eyelids, called the caruncula lachrymalis, should be examined. Just

external to this, a fold of conjunctiva, the plica semilunaris, can be seized with the forceps. Either of these structures is best seen in the student's own eyes when he looks in the looking-glass. At the inner end of the eyelids, just where the eyelashes begin, there is a small elevation, the papilla lachrymalis ; a small dark dot can be seen at the apex of each. These dots are called the puncta lachrymalia, and lead into the canaliculi, which are ducts conveying tears into the nose. A fine probe should be passed into the puncta, and onwards through the canaliculi into the lachrymal sac. The probe having been passed on until its point touches the lachrymal bone, the other extremity should be raised until it crosses the inner angle of the orbit. Steady pressure should now be made in a direction downwards, outwards, and a little backwards, and the probe will be found to enter the nasal duct. This manœuvre is not easy to accomplish on the dead body. The eyelids should next be everted, and the handle of the knife pushed beneath them as far as possible, in order to show the folds of the conjunctiva from the eyelid to the eye. In the dissecting-room, when the eyelids are everted, a number of light-coloured streaks indicate the positions of the meibomian glands. These latter should be carefully examined, and their naked-eye characters made out. The lachrymal glands open by several ducts towards the outer part of the superior conjunctival fold, but these ducts can only be seen in man when specially injected with mercury. The eyelids should now be fastened together, and stuffed with tow or cotton-wool, in order to complete the dissection of the orbicularis oculi muscle. This muscle, which surrounds the eye like a sphincter, consists of two parts : a palpebral, which covers the eyelids ; and an orbicular, which is situated quite outside the lids, and covers the bony edges of the orbit cavity.

The inner edge of the palpebral portion is sometimes called ciliary, but is so pale in colour, and its fibres are so delicate, that considerable skill will be required to display them. The orbicular muscle may now be cleaned by dissecting circularly round the eyes. At the inner canthus the fibres are seen attached to a small tendon, the tendo oculi, which fastens the tarsal cartilages to the nasal process of the superior maxilla. The student should study upon his own face the little lump which indicates its presence. There is a similar band of fibres externally, fastening the tarsal cartilages to the malar bone, but being few in number they are easily overlooked. An incision may now be made through the lower lid into the orbit, in order to expose from in front a muscle, the inferior oblique, which has been already seen. It lies just within, and parallel to, the lower margin of the orbit. There is a small muscle attached to the tarsal cartilages, called the tensor tarsi, or Horner's muscle. It is situated at the inner end of the tarsal cartilages, and close to their internal surface. In order to expose it, the mucous membrane requires to be removed from its surface. To do this, the upper and lower lids are to be divided by a vertical incision about their centre, and their inner ends pulled forwards and inwards with hooks. The con-junctiva is to be removed with care, by beginning

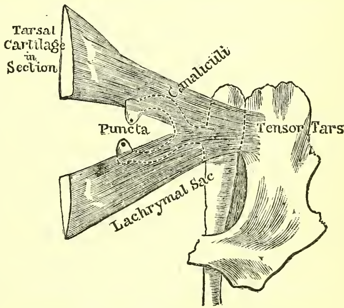


Fig. 34.—Tensor Tarsi seen from behind.

close to the margins of the lids. When the fibres of the muscle have been found, they should be traced to their attachment on the lachrymal bone, and its relations to canaliculi and lachrymal sac made out (Fig. 34). If well injected, the small palpebral arteries may be seen coming from the ophthalmic and lachrymal arteries to form a circle round the lids.

Dissection of nose.—The skin should now be removed from the nose in a thin layer, and the blood-vessels, nerves, muscles, and cartilages dissected. The central fibres of the occipito-frontalis muscle can now be traced down the middle line, to become the pyramidalis nasi. This muscle will serve as a guide to the compressor narium, which crosses over the nose just below the junction of the nasal bones and cartilages. As it is cleaned it will be seen continuous above with the pyramidalis nasi, and care must be taken not to cut away the angular branch of the facial artery, which lies upon the side of the nose. The other muscles of the nose, which serve to dilate and close the nostrils, are of small size. The student should first learn from a diagram or dissection the direction which they take, and then make the alæ of the nose tense with hooks, and dissect them. All the facial muscles should be studied before dissection. The bodies which find their way to the dissecting-room seldom have the muscles of expression well marked, so that disappointment need not be felt if endeavours to find any of them are unsuccessful. When the muscles have been cleaned and learnt, they should be removed when it is found necessary, and the cartilages made out. The terminal branch (naso-lobular) of the nasal nerve should be looked for coming out between the lateral fibro-cartilage of the nose and the nasal bone, and upon the septal cartilage a small branch of the superior coronary artery (*vide* below), the septal artery, traced. A few nasal

branches of the infraorbital nerve may have been seen upon the side of the nose, but being very small are frequently overlooked.

Muscles of the face; muscles of expression.—This group consists of the

Frontalis.
Corrugator supercilii.
Orbicularis oculi.
Elevators of the upper lip, viz.:
  Levator labii superioris proprius.
  Levator labii superioris et alæ nasi.
  Levator anguli oris.
Zygomaticus, major and minor.
Orbicularis oris.
Musculus risorius.
Depressors of lower lip, viz.:
  Depressor labii inferioris.
  Depressor anguli oris.
Quadratus menti.
Buccinator.
Platysma (a few fibres).

The first of these, viz., frontalis, orbicularis oculi, and corrugator supercilii, have already been completed, so that the muscles of the mouth may be begun. The arteries and most of the nerves of the face lie beneath the muscles, and may be dissected afterwards. Commence with the muscles attached to the angle of the mouth. The skin having been reflected, it is probable that the fibres of the zygomatici can be seen extending amongst the fat from the malar bone towards the angle of the mouth. They should be cleaned, and their nerve supply, from the facial, which enters their posterior border, be sought for. In front of the zygomatici, and nearer the nose, are the levator labii superioris proprius, and levator labii superioris et alæ nasi. These muscles run almost parallel to the last, and should be sought for by incisions in the fat below the orbit, and extending from its lower margin towards the angle of the mouth. In cleaning them, they should be put on the stretch by pulling downwards the angle of the mouth with hooks. The dissection of the levator anguli oris had better be deferred awhile. The musculus risorius of Santorini radiates from the angle of the mouth over towards the

parotid region ; its fibres are thin, or may be absent, and lie quite close to the surface. It is easiest dissected by beginning at the angle of the mouth, and tracing it outwards. The angle of the mouth should be drawn towards the opposite side with hooks, to facilitate the dissection. The muscles below the mouth may now be dissected. Beginning at the angle of the mouth, the fibres of the depressor anguli oris should be traced down, until it is seen to be continuous with the platysma myoides. Partially concealed by the depressor anguli oris, and beneath its anterior border, the fairly broad depressor labii inferioris should be looked for. By carefully dissecting round and round the mouth, the fibres of the orbicularis oris should be completed, and it will be seen that the fibres of the muscles already described blend with it.

Lying just in front of the ~~angle of the jaw~~ masseter, and in a slight groove in the bone, is the facial artery. Its course upwards, past the angle of the mouth and by the side of the nose to the inner canthus, should be followed. The muscles beneath which it passes should not be removed, but simply dissected up sufficiently to display the very tortuous course of the artery beneath them. The branches of the facial artery all spring from its anterior border, and run towards the middle line, so that care must be taken in making cuts in this position. The branches which the facial gives off should be traced as far as possible, and their anastomoses made out. The coronary branches may be followed into the orbicularis oris muscle, which they pierce, but their completion may be left until the mouth is opened, when they will be found lying beneath the mucous membrane. These arteries can easily be felt in this position during life, and the student should feel them and their parent trunk in his own person. Lying behind the facial artery, but running a

straighter and more superficial course, is the facial vein. No difficulty will be experienced in tracing it from the centre of the frontal bone to the front border of the masseter, but its branches are not usually made out. They correspond to the arteries.

The nerves of the face have hardly been mentioned. They are derived from the three divisions of the fifth nerve and from the facial. The supraorbital, infraorbital, and mental branches of the fifth should be found in the following manner : The supraorbital branches have been already seen and dissected. It will be remembered that they came out at the notch just below the centre of the upper margin of the orbit, along with a small artery. To see the infraorbital nerve and artery, the levator labii superioris proprius must be either cut through or turned well on one side. When the nerve and its three sets of branches (palpebral, nasal, and labial) have been dissected, the remaining fat in the canine fossa should be removed, and the branches of the nerve pulled aside, to permit the levator anguli oris muscle to be seen and dissected. The mental branch of the inferior dental nerve comes out through the mental foramen in the lower jaw, situated just below the second bicuspid tooth. The depressor anguli oris will require removal before this nerve can be seen. It is therefore evident that a line drawn from the centre of the orbit downwards through the second bicuspid tooth will indicate the positions of these three nerves, and of the small arteries which accompany them. With care the small malar branch of the temporomalar nerve, already mentioned, may be seen coming out of its foramen on the facial surface of the malar bone. The great motor nerve to the muscles of the face, the facial, has not been mentioned yet. Its main trunk will best be seen when the parotid region is dissected. At present a few delicate branches may

have been found entering the posterior margins of the muscles, and converging towards the lobule of the ear. It will be found convenient at this stage to begin the dissection of the parotid region, and afterwards to complete the buccinator muscle and lips.

Parotid region.—By the parotid region is meant the part of the face which is occupied by the parotid gland. It is limited above by the zygoma, below by a line drawn from the angle of the jaw to the mastoid process; behind, it is bounded by the ear and mastoid process; and in front it extends some distance over the masseter, roughly speaking to its anterior border. When the skin has been removed, the following structures are to be sought for in their order:

Lymphatic glands.
Parotid fascia.
Parotid gland and glandula socia parotidis.
Stenson's duct.
Facial nerve.
Auriculo-parotidian nerve.
Temporo-maxillary and external jugular veins.
External carotid artery and its terminal branches.
Transverse facial artery (from temporal).
Masseter muscle.

As a rule, the parotid lymphatic glands are small, and easily escape observation, but they are of considerable importance. Beneath them is the strong parotid fascia; its attachments and its continuity with the fascia of the neck should be made out. It is necessary to remove this fascia in order to see the limits of the parotid gland. This must be done with great care, to avoid cutting through the branches of the facial nerve which pierce it. When the front border of the gland is defined, care must still be taken of the nerves and of Stenson's duct. As soon as this latter structure has been found, it should be traced into the buccinator. A line drawn from the lobule of the ear to the middle of the upper

lip serves as a guide to the duct. In cleaning it, a detached portion of parotid gland will be seen in close connection with it. This is the glandula socia parotidis, and it may be seen to lie on the masseter. Careful search should be made for twigs of the facial nerve emerging from the gland substance, and when one has been found, the gland substance should be gradually cut through, and the branch traced in towards the lobule of the ear. About this point, the main trunk of the nerve will be discovered, and its great divisions, temporo-facial and cervico-facial, made out. Radiating through the parotid from these divisions are all the branches of the nerve. The gland requires to be gradually removed, in order to display them. The temporo-maxillary vein and carotid artery are next to be cleaned. It has just been pointed out that they lie deeper than the nerves, so that these important structures will not be endangered until the nerve has been passed. The branches which the facial nerve gives off before its division into temporo-facial and cervico-facial should be sought for, but as the nerve lies at a considerable depth, this is not easy. Branches of the auriculo-parotidian nerve enter the parotid below the lobule of the ear, very near the place where the external regular vein leaves it. As by this time the posterior triangle of the neck has been dissected, the trunk of the nerve may be traced into the gland from below. The veins are next to be got out. Their formation will be seen to vary somewhat, but usually the temporal and internal maxillary veins unite to form a single short trunk, which divides into two again, one which joins the internal jugular, another which is the external jugular vein. The trunk of the external carotid will be found behind the posterior margin of the jaw and at the lobule of the ear; its division into temporal and internal maxillary should

be defined. If not already sufficiently exposed, the transverse facial artery should be made out, running below and parallel to the zygoma and the auricular parotidian, and deep temporal branches of the temporal artery sought for and cleaned.

The buccinator muscle is now to be finished, but in cleaning out the buccal fat, which lies beneath the front edge of the masseter, care must be taken not to injure the buccal branch of the fifth, which lies beneath the fat, close to the muscle. The nerve is accompanied by a small artery. The muscle should be cleaned from origin to insertion. It may be noticed that Stenson's duct pierces it opposite the second upper malar tooth. There is a papilla at the orifice, which is easy to feel in one's own mouth. A probe should be passed into the mouth from the duct. The sewing of the mouth may now be undone, and the lips everted in order to clean the coronary arteries. In doing this, the mucous membrane and labial mucous glands require removal. The lower lip should be well pulled down, in order to see a band, about half an inch wide, which stands out beneath the mucous membrane. This is the small quadratus menti muscle. The mucous membrane should be removed from it.

The mouth being open, this is a favourable opportunity to see the elevations of the sublingual glands beneath the tongue, also the frœnum of the tongue and the papillæ, which indicate the position of Wharton's ducts. There is a small aperture at the top of each sublingual papilla, which permits a fine probe to be introduced into the ducts. These parts may be studied very easily on the student's own body.

Dissection of the pterygoid region. — This includes the following structures, all of which will require to be dealt with in some part of the dissection.

Zygoma. Lower jaw and temporo-maxillary articulation. Masseter; its nerve and artery. Temporal muscle and fascia. Pterygoid muscles. Internal lateral ligament of the jaw.	Remainder of parotid gland. Internal maxillary artery branches in first and second parts of its course. Internal maxillary vein. Inferior division of fifth nerve. Otic ganglion.

The masseter has been by this time fairly-well exposed, but before doing more at it the student should carefully note the various structures which lie upon it. When this has been done, they should be removed one by one from its surface. Stenson's duct may be cut and turned forwards, and the other vessels and nerves backwards. The student must provide himself with a Hey's saw, bone forceps, and an elevator. The first two have been already mentioned; the latter is simply a slightly-curved bar of steel, with somewhat sharpened and roughened ends. This instrument is by no means essential, but will be found convenient for levering up detached portions of bone. With the Hey's saw divide the zygoma first, in front of the tubercle which is found at its inner end; *i.e.*, tubercle of zygoma, next the malar bone, must be divided in front of the origin of the masseter. This cut should slope downwards a little below and external to the orbit (1 and 2, Fig. 35).

The arch of the zygoma, with the masseter attached to it, may now be turned down. Before this is done, the masseteric nerve and artery should be cleaned and afterwards divided. As the masseter is turned down, its deep fibres attached to the inner surface of the zygoma are brought into view. The coronoid process is next to be cut off in such a manner as to take away with it all the insertion of the temporal muscle. This may be accomplished by an oblique incision from the middle of the sigmoid notch

downwards and forwards towards the last molar tooth (1, Fig. 36). The coronoid process, with the temporal muscle attached, is to be turned up. A portion of the external pterygoid muscle is brought into view, but to complete it more of the maxilla must be removed. This is to be done in such a way as not to injure the inferior dental vessels and nerve, or the

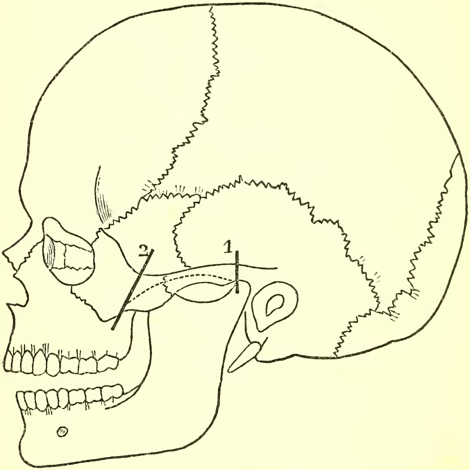


Fig. 35.—Skull, showing Position of Incisions described in the Text.

insertion of the internal pterygoid muscle. From just in front of the neck of the jaw make an incision down the ramus, until the lower end of the cut is on a level with the upper edge of the body of the jaw. A transverse saw-cut should now be made horizontally across the ramus of the jaw (3, Fig. 36). In performing this dissection, the student should have a skull and jaw before him, and frequently refer to them.

As soon as the saw-cuts have extended almost through the bone, the elevator should be used to prize up the outer table. If it comes off alone, so much the better. All risk of injuring the inferior dental nerve and artery will have been avoided. When the portion of the ramus of the jaw has been

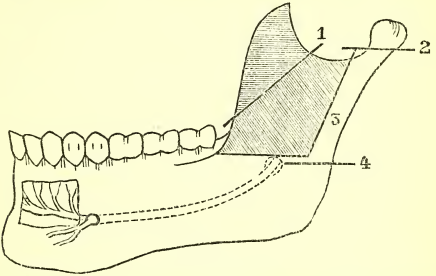


Fig. 36.—Lower Jaw, showing Position of Incisions described in the Text.

removed, the nerves and arteries which emerge between the two pterygoid muscles should be cleaned. The buccal nerve is very frequently cut away as the external pterygoid is being cleaned. It pierces the muscle, and is cut as the fascia is removed from its surface. Another reason why the buccal nerve is divided is, that it not infrequently pierces the temporal muscle as well as the pterygoid. Therefore in cleaning the temporal muscle caution should be exercised as its anterior internal edge is approached. The following structures may now be seen:

External pterygoid muscle.	Inferior dental nerve.
Internal pterygoid muscle.	Internal lateral ligament.
Buccal nerve and artery.	Internal maxillary artery, and its muscular branches.
Gustatory nerve.	

In order to see the most important branches of the internal maxillary artery the lower jaw requires

further manipulation. Cut through the neck with a saw-cut and complete the horizontal cut (4) through the ramus. The vertical bit (3, Fig. 36) must be taken away. Next, open the capsule of the maxillary articulation above the insertion of the external pterygoid. This opens the synovial cavity above the intra-articular fibro-cartilage. With the handle of the knife, and by cutting the remaining portions of the capsule, the fibro-cartilage and condyle of the jaw may be turned out of the glenoid cavity, and pulled well forward with hooks. The external pterygoid muscle will be seen to be attached both to the neck of the condyle and to the front of the fibro-cartilage, and should be pulled well forwards by means of hooks fastened into the fibro-cartilage. The first part of the internal maxillary artery, and other structures which lie between the jaw and its internal lateral ligament, can now be easily completed, and the inferior division of the fifth nerve and otic ganglion dissected. The branches of the inferior maxillary nerve present no difficulties, except the auriculo-temporal. This nerve is closely adherent to the back of the capsule of the inferior maxillary articulation, and is surrounded by dense parotid gland. Moreover, it communicates very freely with the facial. A sharp knife and great patience will be required to make out the nerve and its two roots of origin. Great care must be taken not to pull upon its trunk, or the slender branches which it gives off to the ear and auditory meatus will be broken. The external pterygoid must be pulled strongly upwards and forwards with hooks to enable this to be done.

To find the otic ganglion the student should follow the upper margin of the internal pterygoid muscle up to its highest attachment; a nerve about three-quarters of an inch long will be found entering its upper border. If this, which is the nerve to the

internal pterygoid, be traced up towards its origin from the *trunk* of the inferior division of the fifth, a swelling will be found upon it. This is the otic ganglion. Upon the ordinary dissecting-room parts it is not usual to be able to discover the branches which enter and leave the ganglion; if this is desired to be done, the pterygoid region must be specially hardened in spirit or nitric acid. The gustatory and inferior dental nerves may now be traced, running downwards and forwards from between the two pterygoid muscles. Carefully following the posterior border of the gustatory nerve, the chorda tympani will be found, and may be seen passing upwards until it disappears close to the spinous process of the sphenoid. The inferior dental nerve should be traced by cutting away the outer table of the body of the jaw with Hey's saw, and bone forceps. It can easily be made out ending in mental and dental branches, and with a little pains it may be seen to give off a branch to each tooth fang.

Triangles of the neck.—The body still lying upon its back, the shoulders and neck should be raised to a convenient height with a block, and the head pulled very strongly over to the opposite side by hooks. These latter may be conveniently fastened through the septum of the nose and into the table. The face and pterygoid region must be covered with a damp cloth, and kept for frequent examination. The student will find that if he shows the different structures to his friends he will soon become familiar with them himself. The surface markings of the neck should first be made out. The lower jaw and mastoid process require no further mention. The student should make his finger familiar with the outline of the sternum, clavicle, and acromion process. The anterior edge of the trapezius should be traced, and the sterno-mastoid seen. To make this muscle

stand out, the head should be pulled strongly to the opposite side. When this is done fibres will often come into view crossing the side of the neck. These are the fibres of the platysma myoides. In the living subject, pressure above the clavicle will bring the external jugular vein into view, extending from the middle of the clavicle to a point midway between the angle of the jaw and mastoid process. In the dissecting-rooms its course is usually marked by a line of discoloration. In front of the sterno-mastoid the structures in the middle line of the neck are of especial importance. The rings of the trachea, cricoid cartilage, and hyoid bones should be felt, both on the subject and on the student's own body.

There are two great triangles of the neck, but each is subdivided into smaller ones. Anterior to the sterno-mastoid, and bounded in front by the middle line of the neck, above by the lower jaw and a line drawn from the angle of the jaw to the mastoid process, and behind by the sterno-mastoid, is the anterior triangle. Behind the sterno-mastoid is the posterior triangle; its boundaries are, in front, the sterno-mastoid; behind, the trapezius; and below, the clavicle. It has been previously mentioned that in order to permit the arm to be removed this triangle is conveniently dissected before the orbit or face. It may be well to remember, that it is necessary in dissecting these triangles to learn: (1) their boundaries; (2) coverings; (3) contents; (4) relative positions of contents.

Dissection of posterior triangle of neck.— The following skin incisions should be made: one along the posterior border of the sterno-mastoid, from the mastoid process to the clavicle; another along the border of the trapezius, from the mastoid process to the lower attachment of the muscle; and a third along the upper border of the clavicle. Care must be taken,

in removing the skin, not to injure the platysma myoides, which lies immediately beneath it. The fibres of the platysma should be cleaned; below, it can be seen spreading over the upper part of the pectoralis major; above, many of its fibres have already been traced into the depressor anguli oris. The external jugular vein can be seen beneath it, lying on a layer of strong fascia, the deep cervical fascia. The platysma should be stripped from the fascia and turned upwards, care being taken not to injure the jugular vein or its branches. Only a portion of the deep fascia of the neck can be examined at present, but it is a structure of such importance that its anatomy should be clearly made out; roughly speaking, it makes a sheath for the neck. This sheath is attached above to great bony prominences, the jaw and mastoid process, and is continuous with the parotid fascia already dissected. At the lower part of the triangle the deep cervical fascia is attached to the clavicle, but sends a prolongation beneath it to surround the axillary vessels and nerves. The fascia does a little more than make a ring round the neck. It forms sheaths for the muscles and great vessels. If it were examined in a transverse section made at the situation of the cricoid cartilage, which is opposite the fifth cervical vertebra, it would have, broadly speaking, the following arrangement: behind, it will be found attached to the vertebral spines; traced round, it crosses the trapezius and posterior triangle of the neck. At the posterior border of the sterno-mastoid it splits, to embrace and form a sheath for it. Uniting again at its anterior border, it becomes continuous at the middle line of the neck with the fascia, which is continued from the other sterno-mastoid muscle. In the middle line the fascia is attached to the hyoid bone above; and below, it splits to be attached to the front and back edge of

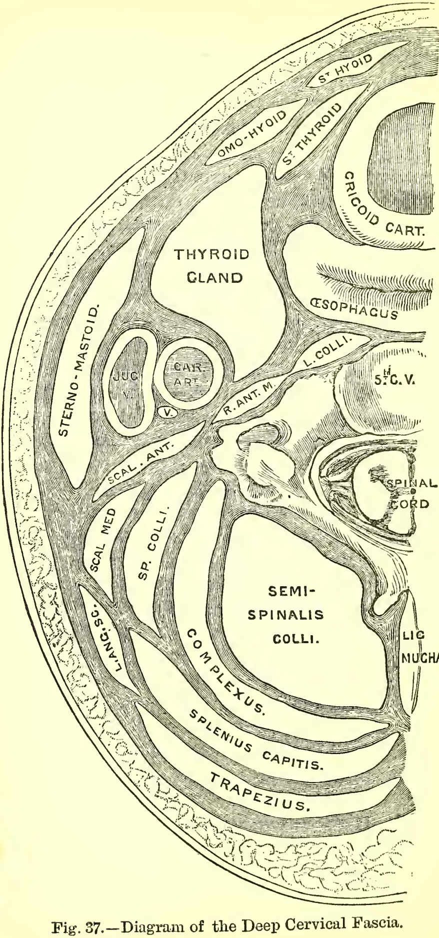


Fig. 37.—Diagram of the Deep Cervical Fascia.

the sternum. Since the bone has a certain thickness, there is an interval between these two layers at the top of the sternum, and at this point a lymphatic gland is frequently found. The great vessels of the neck, and all the deeper muscles, are surrounded by sheaths of fascia (Fig. 37).

It may be laid down as a principle, that fascia are always continuous with one another. It therefore follows that the sheaths of the great vessels and muscles of the neck are continuous with the deeper surface of the cervical fascia. Another way of expressing the same fact would be, to say that the sheaths are prolongations from it. Later on it will be seen that slips of fascia bind down the digastric and omo-hyoid muscles to the hyoid bone, and to the cartilage of the first rib and clavicle, respectively. It will also be seen that another slip separates the parotid from the submaxillary gland, and is attached to the jaw and styloid process, forming the stylo-maxillary ligament. To see all the processes of fascia, a frozen section through the neck would be requisite. But if a general idea of their arrangement be obtained, as the dissection is progressed with, nearly all the prolongations can be made out. A very important one will be seen to pass down behind the sternum to the pericardium. At this stage of the dissection the sheath of the sterno-mastoid should be opened by a cut made a little in front of the posterior border of the muscle. The handle of the knife may be pushed in either direction until the limits of the sheath have been defined. The deep fascia should now be removed from the posterior triangle. As this is done, the slip which binds down the omo-hyoid should be preserved for a little while. The omo-hyoid itself should be cleaned. It will be found to divide the posterior triangle into two. The upper and larger is called the occipital, and the lower and smaller the

subclavian triangle. The following structures have to be made out in the upper triangle:

Muscles bounding it.	External jugular vein.
Its floor formed by	Posterior jugular vein.
Splenius.	Transversalis colli vein.
Levator anguli scapulæ.	Branches of cervical plexus.
Scalenus medius and posticus.	Lymphatic glands.
Transversalis colli artery.	Spinal accessory nerve.

It will be found convenient to clean the veins first, and they should be traced one by one towards the inner end of the clavicle, where they all converge to enter the subclavian. The nerves are chiefly branches of the cervical plexus, which is situated beneath the upper part of the sterno-mastoid muscle. The nerves will, by carefully dissecting along the posterior margin, be seen emerging from beneath the muscle; and when one has been found, it will serve as a guide to the others, which may be traced upwards, downwards, and across to the front of the neck.

The spinal accessory nerve may be distinguished from the other nerves running downwards and outwards, by lifting the sterno-mastoid up, so as to see it emerging from its fibres, or it may be traced into the trapezius below. The small nerve which supplies the posterior belly of the omo-hyoid is very frequently cut away in removing the fascia from the muscle. It should be looked for running close to the upper border of the posterior belly. The only artery contained in this space is the transversalis colli. This vessel arises from the thyroid axis, a branch of the first part of the subclavian, beneath the lower part of the sterno-mastoid. It emerges from beneath this muscle, and passes under the omo-hyoid, amidst a quantity of fat and cellular tissue, to divide beneath the lower part of the anterior edge of the trapezius in its terminal branches. The artery should be searched for by

carefully removing the fat in the lowest part of the occipital triangle and its superficial ascending branch, looked for beneath the edge of the trapezius. Any lymphatic glands which are in the way should be carefully removed. To do this, the knife should be applied close to their capsule; whilst this is being done the gland should be seized with the forceps, and strong traction made upon it.

Subclavian triangle.—The boundaries of this triangle are, below, the clavicle; above, the omo-hyoid; and, internally, the lower end of the sterno-mastoid. Its floor is formed by the scalenus medius and posticus and the first rib. The parts found in it are:

The subclavian artery.	Suprascapular artery.
Subclavian vein.	Brachial plexus of nerves.
Transversalis colli vein.	Descending branches of cervical plexus.
Suprascapular vein.	Nerve to subclavius.
External jugular vein.	Lymphatic glands.
Transversalis colli artery.	

Just beneath the outer edge of the sterno-mastoid muscle lies the scalenus anticus, and upon it the phrenic nerve. These structures are not actually within the triangle, but they are so important that the opportunity should be taken to see their exact relations. The platysma and deep fascia having been removed, the great veins should be followed one by one. As they are usually full of blood, care should be taken not to prick them, and if they are pricked they should be tied. The nerve to the subclavius should be sought for crossing the triangle from above downwards beneath the omo-hyoid, and entering the deep surface of the subclavius. This small nerve runs nearly parallel to the posterior edge of the sterno-mastoid, and not very far from it. When it has been found it is to be preserved, and at a later period a branch may (if the subject is a good one) be found running from it behind the sternal end of the clavicle,

and in front of the subclavian vein, to communicate with the phrenic. Carefully removing the fat and cellular tissue from the subclavian triangle, the suprascapular artery will be found running beneath and parallel to the clavicle, and the transversalis colli artery may be completed. When this has been done, the subclavian vein and artery may be clearly exposed, and above the artery the brachial plexus. If the arm has been sufficiently dissected, the complete dissection of the brachial plexus may be begun. The points which require to be clearly made out are, first, the way in which the plexus is formed ; second, the way in which its branches are given off; third, its relations. To display the plexus clearly, the clavicle should be sawn through about its middle, and the subclavius muscle divided. The arm will by this time have been dissected enough to permit the shoulder to be pulled back, and the ends of the clavicle separated. When this is done, the plexus and all its branches may be cleaned. When this has been accomplished, the student should consult his anatomical text-book, to see which variety of plexus is present. Running parallel to the outer border of the sterno-mastoid, the scalenus anticus should be found, and traced between the subclavian artery and vein to its attachment to the scalene tubercle and dome of the pleura. Lying upon it is the phrenic nerve, and accompanying the nerve a small artery, the ascending cervical, a branch of the inferior thyroid.

Anterior triangle of the neck.—This triangle has been already mentioned. It is bounded in front by the middle line of the neck, behind by the anterior border of the sterno-mastoid, above by the body of the lower jaw and a line drawn from the angle of the jaw to the mastoid process. The omohyoid and digastric muscles cross this triangle and subdivide it into smaller ones, called the inferior

carotid, superior carotid, and digastric. A little later these triangles will be seen to have the following positions and boundaries: the inferior carotid triangles lie between the lower ends of the sterno-mastoid muscles, and are divided from one another by the middle line of the neck. The omo-hyoid forms their upper limit. The superior carotid triangle lies with its base against the upper part of the sterno-mastoid, and has the omo-hyoid below, the posterior belly of the digastricus above, and the sterno-mastoid behind. The digastric triangle is bounded above by the jaw, below by the two bellies of the digastric muscle. To enable the student to mark in these triangles, it is necessary that he should know the relation of the omo-hyoid and digastricus to the surface. A chalk line made from the middle line of the neck, a little above the pomum Adami (the prominence of the thyroid cartilage), to the middle of the clavicle, will indicate the anterior belly of the omo-hyoid. It may be mentioned that it will be found to cross the common carotid artery at the level of the cricoid cartilage. A line drawn from the mastoid process past the edge of the angle of the jaw to the body of the hyoid bone, and thence to the symphysis of the jaw, will mark the position of the digastricus. The body of the hyoid bone is not easy to feel in a fat subject, but lies just above the thyroid cartilage. Although many structures are enumerated as being part of the contents of these triangles, yet it will be found that they do not lie actually within their boundaries, but beneath them.

The skin should now be removed from the whole of the anterior triangle. An incision has already been made from the mastoid process along the lower jaw as far as the symphysis. Make another along the middle line of the neck. The skin should now be dissected in a thin layer backwards towards the posterior border of the sterno-mastoid. A few

cutaneous twigs may be seen emerging from the platysma-myoides, already described, with the posterior triangle; but when the muscle has been reflected upwards and forwards from the posterior triangle, the following structures come into view :

Deep cervical fascia.	Superficial (tranverse) cervical nerve.
External jugular vein.	Cervico-facial nerve.
Anterior jugular veins.	Sternal branches of cervical plexus.
Auriculo-parotidean nerves.	

The deep cervical fascia has been already described, but as the dissection progresses the student must remember to verify the description. The cervical branch of the facial nerve should be traced down from the trunk, and its communications with the superficial cervical nerve made out. This can easily be done if the body is a lean one. The branches of the superficial cervical plexus were found before emerging from the posterior border of the sterno-mastoid. If not already exposed, the superficialis colli or transversalis colli nerve will be found just at the place at which the external jugular vein leaves the posterior border of sterno-mastoid. The nerve, which is sometimes of small size, hooks round the vein, and may sometimes be seen to pierce it. The auriculo-parotidian nerve will be found running upwards with the external jugular vein. A small unnamed nerve will generally be found also running with the vein on the sterno-mastoid. The sternal branches of the cervical nerve run downwards over the sterno-mastoid, but are smaller and more difficult to find than those already mentioned. Nothing more need be said about the external jugular vein. The anterior jugulars will be seen in the anterior triangles, almost in the middle line. If there is only one vein, it usually occupies the middle line and may be of considerable size. Usually there are two, beginning

amongst the muscles beneath the jaw. The main trunk of the vein should be cleaned and traced upwards, and afterwards downwards beneath the sterno-mastoid to its termination in the external jugular or subclavian veins. It may be remarked that the appearance of these veins on the dead body in their collapsed state gives hardly any idea of their size and importance during life.

To expose the inferior carotid triangles the deep fascia should be removed. If a commencement be made at the anterior border of the sterno-mastoid, and the fascia dissected forward, it may be seen to pass both in front and behind the depressor muscles of the hyoid bone. (*Vide* Fig. 37, page 256.) These muscles lie near the middle line, and form part of the floor of the triangle. Care must be taken in cleaning them not to cut through their nerve-supply, which comes from the descendens noni and enters their posterior external borders. Although not all actually in the inferior carotid triangles, the following structures may be enumerated as their contents :

Sterno-hyoid, and	Inferior thyroid artery and vein.
Sterno-thyroid muscles.	Trachea.
Common carotid artery, Internal jugular vein, Pneumo-gastric nerve, } in sheath.	Larynx.
Sympathetic nerve.	Recurrent laryngeal nerves.
Descendens and communicantes noni nerves, joining to form the ansa-hypoglossi.	Œsophagus on left side.
	Thyroid gland.
	Glandulæ concatenatæ.

The coverings of the triangles and their superficial nerves and veins have been already mentioned. The importance which belongs to this triangle is due to the fact that it contains the trachea and common carotid artery, and, it may be added, the œsophagus, on the left side. These structures are not infrequently involved in surgical procedures, and therefore their

anatomical relations are of the greatest importance. To dissect the common carotid, the anterior belly of the omo-hyoid should be defined, in order to see the point at which it crosses the artery. The sterno-mastoid should be pulled outwards with hooks; when this is done, the loop formed by the descendens and communicans noni are to be looked for in the upper part of the space. When the position of these nerves has been made out, a tube of fascia will be seen beneath the border of the sterno-mastoid. This, having been opened by vertical incisions, will be found to contain the common carotid artery, internal jugular vein, and pneumo-gastric nerve. Their relations should be studied and examined again and again, until the student is quite familiar with them. If the sterno-hyoid muscles be pulled in towards the middle line, and the cellular tissue between the common carotid and the trachea removed, the inferior thyroid artery and vein may be seen running behind the common carotid from the lower part of the sterno-mastoid, to enter the under-surface of the lateral lobe of the thyroid body. On the left side the œsophagus is easily seen bulging from behind the trachea and in close relation with the carotid artery. In this part of its course the œsophagus looks not unlike ordinary voluntary muscle. By carefully dissecting between the œsophagus and trachea, the recurrent laryngeal nerves may be brought into view, and traced upwards to enter the larynx beneath the lower borders of the thyroid cartilage and inferior constrictor muscle. The lower part of these nerves must be left until a later period. No attempt should as yet be made to get out the sympathetic unless it lies superficial to the inferior thyroid artery, in which case its middle ganglion lies upon the arterial trunk; it is sometimes called the thyroid ganglion. It will be found most convenient

to defer awhile the further consideration of the contents of this triangle, but the attachments of the sterno-hyoid and sterno-thyroid muscles may be partially got out. A great many lymphatic glands surround all the great vessels of the head and neck. They are called the glandulæ concatenatæ, and should be removed when they obscure the view of the other structures. To remove them, they should be seized with the forceps and dragged upon; whilst this is done, the knife should be applied close to their capsule, until they are free.

The **superior carotid triangle.**—The boundaries of this triangle have already been described. They should now be clearly defined. The contents which are to be dissected are:

The floor, consisting of Portions of thyro-hyoid. " hyo-glossus. " middle constrictor. " inferior constrictor.	Common carotid artery, and its division into External carotid and Internal carotid. Branches of external carotid: Superior thyroid. Lingual. Facial. Occipital. Ascending pharyngeal.

The veins which run with these arteries, and which empty themselves into the internal jugular:

Hypoglossal nerve, and its branches. Descendens nerve. Nerve to thyro-hyoid muscle. Pneumogastric nerve.	Superior laryngeal nerve. Spinal accessory nerve. Sympathetic. Larynx, Pharynx } partially. Greater cornu of hyoid bone.

The coverings of the triangle having been previously dissected may now be removed. No particular directions are requisite for the removal of the deep cervical fascia from this space. When this has been done, the boundaries of the triangle should be clearly defined,

and then the descendens noni should be sought for and traced upwards ; it will be found to lead to the hypoglossal nerve, which should be exposed as it crosses the external carotid. The structures of the greatest importance contained in this triangle are the common carotid artery and its two branches of division. The upper part of the carotid sheath should first be opened, and the common carotid traced upwards as far as the upper edge of the thyroid cartilage, where it divides. From this point the external carotid may be traced until it is lost beneath the posterior belly of the digastricus. The precaution having been taken to find the hypoglossal nerve, and its descending branch, there will be no fear of cutting it away. The branches of the external carotid should now be followed from the main trunk. Usually the superior thyroid artery can be seen lying quite superficially in the triangle. The main trunk of this vessel should be cleaned until it ends on the thyroid body ; but in doing this, particular care must be taken not to remove any of its small branches : viz., hyoid, internal laryngeal, sterno-mastoid, and external laryngeal or crico-thyroid. The hyoid branch should be looked for running close beneath the thyro-hyoid muscle, and at the lower border of the hyoid bone. When this artery is being dissected, care must be taken not to cut away a very slender branch of the hypoglossal nerve, which runs across it to enter the thyro-hyoid muscle. This small nerve having been found, where it lies in the greater cornu of the hyoid bone, and traced to the thyro-hyoid, the muscle itself may be cleaned. The omo-hyoid and sterno-hyoid may be pulled aside to permit this to be done. The internal laryngeal branch of the superior thyroid artery should be traced, with its accompanying nerve, beneath the thyro-hyoid muscle to enter the membrane (thyro-hyoid) which stretches from the thyroid cartilage to

the upper posterior border of the hyoid bone. The course of the artery when inside the membrane will be studied later on, when the larynx is dissected. The sterno-mastoid branch should be traced into the sterno-mastoid muscle, passing over the upper part of the common carotid artery. The external laryngeal, or crico-thyroid artery, remains to be followed across the crico-thyroid membrane. The student is recommended not to endeavour to do too much at these small arteries lying upon firm textures, such as the crico-thyroid membrane. They only require to be defined by taking hold of the connective tissue near them; and as it is pulled away, delicate cuts should be made along the outline of the vessel, but without touching it. All of the arteries which have been dissected have corresponding veins, but owing to their smallness and their empty condition they will probably escape notice.

Arising from the external carotid, opposite the cornu of the hyoid bone, are the lingual and facial arteries. At present these vessels should merely be traced: the lingual, until it disappears beneath the hyo-glossus; the facial, until it passes beneath the posterior belly of the digastric and stylo-hyoid muscles. The occipital artery, arising from the back of the external carotid, should be followed upwards as far as the posterior belly of the digastricus. The way in which the hypoglossal nerve winds round it should be noted, and care must be taken not to cut away its sterno-mastoid branch. This small artery enters the upper part of the sterno-mastoid muscle along with the spinal accessory nerve. When it has been found, this small artery serves as a guide to the nerve. At present only a small portion of the spinal accessory nerve can be seen emerging from beneath the digastricus and stylo-hyoid, but it should be sought for and traced into the deep surface of the sterno-mastoid muscle. The commencement of the internal

carotid should now be cleaned, and the dissection of the internal jugular vein continued. The pneumogastric nerve has the same relation to the internal carotid artery and jugular vein which it used to have to the common carotid and internal jugular vein. By searching amongst the connective tissue near the internal laryngeal artery, a small nerve can be found entering the larynx through the same aperture in the thyro-hyoid membrane. This is the internal laryngeal branch of the superior laryngeal nerve. Another branch of the superior laryngeal nerve, the external laryngeal, may be found accompanying the crico-thyroid artery. It will be found more convenient to do nothing further at the superior carotid triangle at present, but to wait until a later stage, when the structures seen in it can be traced in their continuity.

The **submaxillary or digastric triangle.**—The lower jaw should be pulled strongly up with hooks, and the head thrown backwards. When this is done, and when the platysma has been removed, the submaxillary gland may be seen beneath the jaw, concealed by the deep cervical fascia. The fascia may be removed from the gland and remainder of the submaxillary region. The knife should be carefully applied close to the submaxillary gland, and dipped in between its lobules, so as to define them. The student will observe how much coarser they are than the lobules of the parotid. When the gland has been fairly well freed from the surrounding fascia, it should be lifted gently, and hooked up towards the face. This brings the two bellies of the digastric muscle into better view. The boundaries of the submaxillary triangle should now be defined. In cleaning the posterior belly of the digastricus, its tendons will be seen to pass through the fibres of the stylo-hyoid muscle, just before the latter is inserted into the hyoid bone. Next, the anterior

belly should be cleaned.* The superior boundaries of the triangle are the lower border of the inferior maxilla, and a line drawn from the angle of the jaw to the mastoid process. It will be remembered that this was the line which defined the lower margin of the parotid gland. In most cases the parotid extends into the posterior part of the submaxillary triangle. It is very convenient to divide the submaxillary triangle into an anterior and a posterior part. The stylo-maxillary ligament, which separates the submaxillary from the parotid gland, forms a natural boundary. The front part of the triangle contains the

Hyo-glossus.
Mylo-hyoid.
(?) Anterior belly of digastricus.
Submaxillary gland (salivary).
Submaxillary glands (lymphatic).

Facial artery and its cervical branches.
- Submental.
- Submaxillary.
- Ascending palatine.
- Tonsillar.

Facial vein.
Mylo-hyoid nerve and artery.

The posterior part of the triangle may be said to contain the structures given in the list below; but the same remark applies to this space as was applied to the inferior and superior carotid triangles, that many of the things are not really contained in them, but lie just outside. It will be found convenient to dissect the structures in the posterior part of the triangle in the following order:

(1) The external carotid.
(2) Parts between the external and internal carotid, including the styloid process and things attached to it.
(3) Structures beneath the styloid process.

* Some authors, instead of giving the jaw, and bellies of the digastric muscles, as the boundaries of the submaxillary triangle, give the middle line of the neck as the front boundary, and include the anterior belly of the digastricus in the floor.

In the meantime, the dissection of the front part of the triangle will be proceeded with. This dissection includes the following stages :

(1) Structures above the mylo-hyoid.
(2) Reflection of mylo-hyoid.
(3) Structures beneath mylo-hyoid lying upon hyo-glossus.
(4) Reflection of hyo-glossus.
(5) Structures beneath hyo-glossus.

In dissecting the parts above the mylo-hyoid, the facial vein should first be traced from the anterior edge of the masseter towards the internal jugular vein. It receives many important branches, but being small and collapsed, the student is not likely to make them out. It will be observed that the facial vein does not run with the artery. No difficulty will be experienced in tracing the facial artery, either downwards from the groove on the lower jaw into the submaxillary gland, which it pierces, or upwards from beneath the digastricus. As the facial lies in the substance of the submaxillary gland, it gives off numerous branches to it; these are the submaxillary arteries. Just before passing over the jaw, the facial gives off a branch which runs under the cover of bone and upon the mylo-hyoid muscle as far as the chin. This is the submental artery, and in cleaning it care should be taken lest a small nerve, the mylo-hyoid, be cut away. The artery serves as a guide to this small nerve, which, being carefully dissected, will be seen to give off branches to the mylo-hyoid muscle, and to terminate in the anterior belly of the digastricus. Immediately beneath the angle of the jaw the facial artery gives off a small branch to the internal pterygoid muscle, and before entering the submaxillary gland it gives off the palatine and tonsillar branches, which may be left until the dissection has progressed a little farther. The mylo-hyoid muscle may now be cleaned,

and the structures which lie above and below it learnt. To see the muscle plainly, the submaxillary gland should be hooked well up, and the anterior belly of the digastricus removed from its attachment to the lower jaw, and turned downwards. The origin of the mylo-hyoid from the body of the hyoid bone and from a median raphé should be made out, and the fibres traced to their insertion into the mylo-hyoid ridge of the lower jaw. The muscle will be seen to be quadrilateral in shape, and if one finger be placed in the mouth beneath the tongue, and another beneath the muscle, it will be found to form the floor of the mouth. Owing to this circumstance, it was formerly called diaphragma oris. It is now time to reflect the mylo-hyoid, and dissect the parts beneath it. In order to do this, the submaxillary gland should be pulled well out of the way, the facial artery being, if necessary, divided as it enters it below. When the gland is being turned up, its duct may be cleaned, as it winds round the posterior edge of the mylo-hyoid. The digastricus, having previously been cut away from its attachment and turned backwards, the symphysis of the lower jaw may be sawn through, and the body drawn well upwards with hooks. The pterygoid region having been dissected this can easily be done. The tip of the tongue should have a string fastened through it, and then it should be pulled well out of the mouth. Lastly, the mylo-hyoid muscle should be cut from its attachments to the body of the hyoid bone and median raphé, and turned upwards.

The following structures are to be brought into view :

Genio-hyoid muscle.
Genio-hyo-glossus muscle.
Hyo-glossus.
Stylo-glossus and lingualis.
Deep portion of submaxillary gland.
Wharton's duct.

Sublingual gland.
Hypoglossal nerve.
Lingual nerve.
Submaxillary ganglion.
Lingual artery and some of its branches.
Lingual vein.

A great many of these lie upon the hyo-glossus muscle, and when they have been cleaned and the muscle defined, the next stage of the dissection, to reflect the hyo-glossus and see the parts beneath it, may be begun. The hypoglossal nerve has already been found ; its dissection may now be completed, and its communications with the lingual nerve on the hyo-glossus made out. The lingual nerve lies upon the upper part of the hyo-glossus, and may be mistaken for Wharton's duct, which is crossed by it. Wharton's duct may be recognised by tracing it from the deep part of the submaxillary gland. To see the whole of its course, a small probe may be passed into it through an incision in its wall, and pushed on until it emerges on the floor of the mouth. It passes beneath the sub-lingual gland, which should be cleaned and lifted up, to display its relation to the duct and to the lingual nerve and ranine artery.

In dissecting the lingual nerve, care must be taken not to remove the submaxillary ganglion. By carefully cleaning along the lower border of the lingual nerve, a small reddish lump will be found close to the posterior edge of the hyo-glossus. This is the ganglion, and it will usually be found attached to the lingual by small branches. When the body is thin and fresh, branches can usually be traced from the submaxillary ganglion to the submaxillary gland, but its other branches to the ducts and floor of the mouth require to be found upon a specially prepared part. The lingual nerve may now be traced to its termination upon the front and sides of the tongue. The relations of the sublingual gland should be studied, and in lifting it up an endeavour should be made to see its numerous ducts. They are very delicate, and often escape notice. The lingual vein, instead of running with the artery beneath the hyo-glossus, usually runs over the muscle just above the

hypoglossal nerve. The stylo-glossus may now be cleaned, from its origins to its insertions, and the next stage of the dissection proceeded with. The hyo-glossus should be removed from its attachments to the body and greater and lesser cornua of the hyoid bone, and turned upwards. When this is done, the following structures must be dissected :

Lingual artery, and its branches.	Middle constrictor.
Hyoid.	Stylo-hyoid ligament.
Dorsalis lingual.	Glosso-pharyngeal nerve.
Sublingual.	Attachments of the genio-hyo-glossus into tongue and hyoid bone.
Ranine.	

The lingual artery should be first traced running just above the hyoid bone and along the side of the tongue to its tip. The more the tongue is dragged out of the mouth, the straighter the artery becomes, and the easier it is to dissect. Beneath the hyo-glossus and close to the lesser cornu of the hyoid bone, a small branch (the dorsalis linguæ) may be seen ascending from the lingual. The finger may be pushed into the mouth over the back of the tongue and turned outwards, in order that the relations of the hyo-glossus to the tongue may be properly understood.

Before passing beneath the hyo-glossus the lingual gives off a small hyoid branch, which may be followed along the upper border of the hyoid bone. After emerging from beneath the hyo-glossus and where it lies upon the genio-hyo-glossus, a branch (sublingual) may be traced from it into the sublingual gland. After it has been given off, the continuation of the artery is called the ranine.

The glosso-pharyngeal nerve is not easy to find just at present. If not seen passing beneath the posterior edge of the hyo-glossus, the student should wait until the stylo-pharyngeus is dissected, when it

can easily be seen winding round its posterior edge. The stylo-hyoid ligament may be traced upwards from the lesser cornu of the hyoid bone. The lesser cornu can be felt with the finger, but it may be remarked that it is better to avoid touching the dissection with the fingers, as it dirties and obscures the different tissues.

Dissection of the posterior part of the submaxillary triangle.—The dissection of this region is difficult, and will greatly tax the skill of the dissector. The lower jaw has by this time been manipulated in such a manner that its angle can easily be pulled forward with hooks. The sterno-mastoid should be pulled strongly backwards by means of hooks fastened to about its middle. If this muscle be very fleshy, a later stage of the dissection may be anticipated, and it may be divided about its centre, and its ends pulled backwards. The head itself should not be thrown too far back, but have a block beneath it, and be inclined slightly away from the dissector. To bring the external carotid into complete view, any remaining portions of the parotid gland should be removed, and the posterior belly of the digastric and the stylo-hyoid cleaned. When this has been done, they should be removed from their attachments to the hyoid bone, and drawn backwards to expose the external carotid as it passes beneath them. As these muscles are dissected back, branches from the facial nerve should be looked for entering their upper part.

The remaining branches of the external carotid may now be completed. The posterior auricular has already been mentioned, and its origin from the carotid, just above the digastricus, will be seen as the parotid is taken away. Immediately below the digastricus the occipital arises from the carotid. It is crossed at its origin by the hypoglossal nerve, and runs upwards to pass between the atlas and mastoid

process. The student should feel the transverse process of the atlas, and ascertain how far it protrudes beneath the mastoid process.

Only a small part of the occipital can at present be traced, but in cleaning it care must be taken not to remove its meningeal branches, which are given off as it crosses the internal jugular vein, or a large branch (superior sterno-mastoid) which it sends to the sterno-mastoid. The artery may be completely followed between the atlas and mastoid process later on. As the whole of the external carotid artery has now been exposed; its relations should be examined and learnt; the places where it begins and where it ends determined; and, more particularly, the student should note what incisions would be required to expose it in any part of its course.

The parts which lie between the two carotids are now to be dissected; they are

Stylo-hyoid ligament, or Styloid process itself. Stylo-glossus and stylo-pharyngeus.	Glosso-pharyngeal nerve. Pharyngeal branch of vagus occasionally, and a portion of parotid gland.

The styloid process varies in length in different subjects. The stylo-hyoid ligament extends from its apex to the lesser cornu of the hyoid bone. This ligament becomes ossified as age advances, and adds greatly to the length of the process. Both the ligaments attached to the styloid process (stylo-hyoid and stylo-maxillary) have been mentioned before, and partially seen; the muscles may now be studied. Beginning from the apex of the process, they are the stylo-glossus, stylo-hyoid, and stylo-pharyngeus. The stylo-glossus is seen attached more to the stylo-maxillary ligament than to the process, and the stylo-hyoid has already been dealt with. The stylo-pharyngeus must be cleaned, but care must be taken to find the glosso-pharyngeal nerve winding round

its posterior border. If the glosso-pharyngeal be drawn a little way from the muscle, it will be seen to give off a small branch to it. The stylo-pharyngeus may be followed down to where it disappears beneath the middle constrictor of the pharynx, to be attached to the posterior border of the thyroid cartilage.

Before the structures beneath the styloid process can be properly dissected, it is necessary to draw the external carotid well out of the way, or even to divide it if necessary, and turn its ends up and down. With the bone forceps the styloid process should be nipped through, as near the base of the skull as possible. In doing this, care must be taken not to injure the facial nerve or stylo-mastoid artery. The process, and all the muscles attached to it, are to be turned forwards. The structures which require dissection are the

Internal jugular vein.	Pneumo-gastric, or vagus.
Internal carotid artery.	Glosso-pharyngeal.
Ascending pharyngeal artery.	Hypoglossal.
	Sympathetic.
Spinal accessory nerve.	Deep cervical plexus.

The student is advised to have the base of a skull before him, and to constantly refer to the apertures by which these important structures enter and leave the skull. The following facts have at present to be ascertained about the cranial nerves: (*a*) Their origin from the brain, *i.e.*, superficial origin; (*b*) their mode of exit from the skull; (*c*) their course; (*d*) their termination; (*e*) their largest branches and communications. It will be found convenient to begin with the deep cervical plexus. The sterno-mastoid having been previously drawn upwards, the anterior divisions of the cervical nerves can be seen emerging just external to the internal jugular vein.

The first four cervical spinal nerves constitute the

cervical plexus. The following figure (Fig. 38) may assist the student in understanding them. If the sub-occipital triangle has been dissected, the greater part of the first cervical nerve will have been seen. It

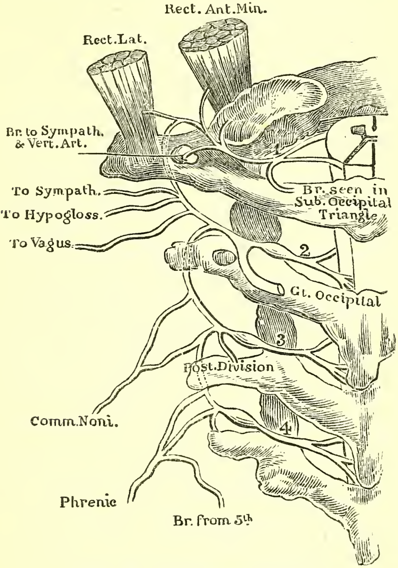


Fig. 38.—Deep Cervical Plexus.

was pointed out that the whole of the first nerve emerged from the spinal canal beneath the vertebral artery, between the artery and the posterior arch of the atlas. Where the suboccipital nerve lies beneath the vertebral artery, it gives off a large branch, which passes round to the front of the vertebral column in the following manner: it passes forward

over the atlas, lying at first between the occipito-atloid articulation and the vertebral artery, *i.e.*, internal to the artery; afterwards it emerges in front between the rectus capitis lateralis and the rectus capitis anticus minor, and external to the rectus capitis anticus major. After emerging, this anterior branch of the suboccipital nerve turns downwards over the front of the lateral mass of the atlas, to communicate, or form a loop, with the anterior division of the second cervical nerve. Before endeavouring to dissect either the first or the second cervical nerve the student should get an atlas and a skull, and carefully marking in the loop formed by the first and second cervical nerves, he will then see how very near the loop is to the anterior condyloid and posterior lacerated foramena, and the carotid canal. The second cervical nerve may also have been seen, if the suboccipital triangle has been dissected; the great posterior branch will have been dissected, and is called the great occipital nerve. The second cervical nerve differs from those below in this, that it does not emerge from the spinal canal at the intervertebral foramen, but between the posterior arch of the atlas and lamina of the axis. The anterior division of the second winds *outside* the vertebral artery to the front; the anterior divisions of other cervical nerves wind round to the front in a similar manner; and each, when it has passed the vertebral artery, divides into a branch which ascends in front of the transverse process to the nerve above, and one which descends in front of the transverse process to the nerve below. These loops constitute the deep cervical plexus. The upper end of the sterno-mastoid having been pulled upwards and backwards, no difficulty will be experienced in making out the second, third, and fourth, and in tracing the communicantes noni and phrenic to them.

The anterior surface of the rectus lateralis may be partially cleaned, care being taken not to injure the occipital artery, which lies upon its outer side. In some bodies the anterior branch of the suboccipital nerve may be found coming out at its inner edge; if any difficulty is experienced in finding it, the student had better wait until a later stage. Nearly all the other branches of the cervical plexus have been dissected, but the student should consult his text-books for additional information. The hypoglossal nerve may now be traced upwards, and generally seen to blend with the vagus at a point where the latter displays an elongated swelling, its inferior ganglion. The hypoglossal at this point is concealed by the internal jugular vein, internal to which it passes. To continue tracing the nerve, the internal jugular vein should be tied, about two inches from the skull, with two strings, and divided between them; its upper end may now be pulled outwards. The hypoglossal can almost be followed into the anterior condyloid foramen, but in tracing it care must be taken not to cut away the branch of communication which it receives from the first cervical loop, or the branches which it receives from the sympathetic. To preserve these communications requires considerable skill and patience, even if the body is fresh and lean. The glosso-pharyngeal nerve has already been found winding round the posterior border of the stylo-pharyngeus. It may also be traced upwards, until it appears to be lost between the internal jugular vein and internal carotid artery.

A branch may be found given off from the glosso-pharyngeal higher up. It runs down to join the sympathetic on the internal carotid arteries. Usually this carotid branch may be traced to a small ganglion, situated at the bifurcation of the carotids, and called the ganglion intercarotidum. Underneath the

stylo-pharyngeus, and lying upon the side of the pharynx is a meshwork of nerves, called the pharyngeal plexus. A branch given off from the trunk of the glosso-pharyngeal may be traced into it, and presently branches from the vagus and sympathetic. No very explicit rule can be laid down for finding the pharyngeal branch of the glosso-pharyngeal; but by beginning to clean the glosso-pharyngeal near the base of the skull, and gently pulling on the main trunk, the branches which have been mentioned can be seen. The trunk of the vagus may now be cleaned. Its communications with the cervical nerves, sympathetic, glosso-pharyngeal, and spinal accessory, are to be made out, but the two last-named communications must be left until the ganglia of the glosso-pharyngeal and the superior ganglion of the vagus are begun. At present the two large branches which come from the ganglion of the trunk, or lower ganglion of the vagus, may be traced. The pharyngeal branch has been already mentioned. It may be found given off from the middle of the ganglion, and traced either over or under the internal carotid to the plexus beneath the stylo-pharyngeus. The laryngeal branch is of considerable size, and is usually given off from the lowest part of the ganglion of the trunk. It should be traced downwards between the pharynx and internal carotid, whilst it will be found to divide into a branch which has been already seen entering the larynx, and another branch which has been seen running with the superior thyroid artery. This latter is the external laryngeal nerve. It is usually rather delicate, but, with a little skill, may be followed beneath the depressor muscles of the hyoid bone into the crico-thyroid muscle. In a favourable subject, by beginning to dissect the nerve from its origin, where it is strong and thick, slender branches can be traced from it into the thyroid body, inferior constrictor

muscle of the pharynx, and a very delicate one to join the cardiac nerves. The sympathetic has already been seen lower down in the neck. It lies behind the carotid sheath, but very near the vagus, for which it may be mistaken. However, the sympathetic is much thinner, and ends above in a larger ganglion. The trunk of the sympathetic should be followed upwards to its superior ganglion, which will be found opposite the first, second, and third cervical vertebræ, almost concealed by the internal carotid artery. This ganglion sends numerous slender twigs to all the nerves in its vicinity. If the part has been hardened in spirit or nitric acid, these branches may be made out, but upon an ordinary subject only the largest can be found emerging from the ganglion.

The internal carotid artery may now be cleaned, and lying between it and the pharynx the ascending pharyngeal artery may be found, but its complete dissection may be left until the dissection of the pharynx.

It will be remembered that the student was advised to defer the dissection of the tonsilar and palatine branches of the facial artery. They may now be found, and traced up. The palatine branch lies between the stylo-glossus and stylo-pharyngeus; the tonsilar branch runs over the stylo-glossus, and disappears into the constrictors.

Dissection of posterior lacerated foramen and carotid canal.—There now remains for dissection the structures which leave the skull by the posterior lacerated foramen, and, after this has been done, the carotid canal and its contents. This dissection includes

The upper part of the spinal accessory nerve.	Both ganglia of the glosso-pharyngeal.
Superior ganglions of the vagus.	Anterior branch of sub-occipital nerve.
	Carotid canal and contents.

Roughly speaking, the jugular foramen lies beneath the mastoid process, and is concealed from view by the vaginal process of the temporal bone. It also lies behind the temporal bone, and in the suture between it and the occipital bone. In order to expose it, the muscles attached to the mastoid process are to be detached in their order, and the occipital artery completed. Afterwards the skull must be sawn in such a manner as to enable the dissector to force the temporal bone well forwards, and so open the lacerated foramen through the temporo-occipital suture. If the parotid, pterygoid, and styloid process regions have been dissected according to the rules laid down in previous paragraphs, the dissection may be proceeded with in the following way. The sterno-mastoid should be stripped from the mastoid process and superior curved line of the occipital bone. The upper half of the muscle may now be completely removed, all except a piece about the size of a shilling, left where the spinal accessory enters it. The splenius trachelo-mastoid and digastricus are to be removed close to the bone. The occipital artery is to be completely cleaned as it passes over the rectus lateralis, and, if necessary, removed. Before taking any part of the vessel away, it should be seen what its exact relations are, what it crosses, and what would have to be removed to expose it. All its branches are to be noted. The princeps cervicis is the most important, and by this time will probably have been dissected with the back of the neck.

The bones require the following sections: the greater wing of the sphenoid should be cut away with the forceps until the foramen ovale is reached. Part of the squamous portion of the temporal may be removed in a similar manner, if it prevents the rest of the bone being displaced. A saw-cut should be made behind the mastoid process into

the lateral sinus, where it grooves the temporal bone, and thence into the jugular foramen. The temporal bone may now be displaced forward into the gap left by the removal of the sphenoid. It is generally necessary, in order to make the dissection easier, to cut away the greater part of the squamous portion of the occipital bone with the saw. The internal jugular vein may first be cleaned, and stuffed with a little wool. This sometimes makes the dissection easier. The meningeal branches of the occipital previously seen may be completed. The loop between the first and second nerves may be completely and easily dissected, and its branches of communication made out. Later on, the suboccipital will be seen as it crosses the atlas, and other branches discovered (Fig. 38, page 277). The hypoglossal may now be completely cleaned; and afterwards the spinal accessory, glosso-pharyngeal, pneumo-gastric, and sympathetic, dissected. Before undertaking this very arduous task, the student should endeavour to study the relations and communications of these nerves upon a dissected specimen, and in doing this he should frequently refer to a text-book. He need not feel greatly disappointed if he fails to discover all the branches or ganglia which are spoken of. Here it will be indicated what a skilful dissector can usually make out. The dissection need not necessarily be conducted in this particular order, but may be modified as found convenient. It will be found best to trace the nerves from below, and when the main trunk has been made out, to follow out the branches and communications. If the spinal accessory nerve be followed upwards behind the jugular vein, a large part of it (the accessory) may usually be seen to enter the superior laryngeal branch of the vagus. Sometimes a portion may be followed into both the vagus and into its pharyngeal branch. The glosso-pharyngeal

may be traced upwards between the internal jugular vein and carotid artery. There are usually said to be two ganglia upon it. The upper ganglion of Müller is never seen upon an ordinary dissecting-room body; indeed, its very existence may be doubted. The lower ganglion (petrous ganglion, or ganglion of Andersch) lies in a slight depression on the petrous bone. It is often closely united to the superior ganglion of the pneumo-gastric, with which it always communicates. This ganglion often can hardly be said to exist. If the ridge of bone between the jugular fossa and the carotid canal be carefully cleaned, a small nerve (Jacobson's) may be followed from an aperture in it running to join the inferior ganglion of the glosso-pharyngeal. The remainder of its course will be seen later on. If the vagus be now traced upwards from its inferior ganglion, which has been already cleaned, a smaller and rounder swelling may generally be seen upon the nerve above it. This, which is the superior ganglion, or ganglion of the root, communicates with other nerves, especially the glosso-pharyngeal, but only gives off one small branch of distribution, called Arnold's nerve. This small twig may sometimes be found lying near the bone, and upon the back surface of the jugular vein, but much time need not be spent in trying to find it.

Carotid canal.—The superior cervical ganglion of the sympathetic has already been dissected, and its communications made out. The main trunk should now be followed up until it enters the bone with the internal carotid artery. To expose the carotid canal, its posterior wall should be cut away with bone forceps, and the artery followed into the skull, where it has been seen and cleaned. The sympathetic sometimes has a ganglion (carotid ganglion) upon it, as it lies in the carotid canal, and usually sends a branch into the tympanum.

Dissection of the back.—When the back is dissected particular attention should be given to the following points :

Surface markings.
Cutaneous nerve-supply.
Attachments of superficial muscles.
Suboccipital triangle, and
Back of neck.
Muscles of back (deep).
Structures between last rib and crest of ileum.

The surface markings are comparatively simple, and include

Occipital protuberance, and superior curved line of occipital bone.
Spines of vertebræ and ribs.
Spine and outline of scapula.
Crest of ileum.
Outlines of latissimus dorsi, and
Trapezius and erector spinæ.
Outlines of lungs and liver.
Kidneys.
Ascending and descending colon.

Most of these require no further mention. The lungs and liver have been shown elsewhere. (*Vide* frontispiece.) The kidneys should be marked in, so that their hilum is about opposite the first lumbar spine, and about two inches external to it. The upper border of the right kidney reaches as high as the lower border of the eleventh rib. Below, it nearly reaches the ileum. The left kidney is not so low. It reaches the lower border of the tenth rib, and does not extend quite so near the ileum as the right. (*Vide* Fig. 13.) The right and left colons lie beneath a line drawn vertically upwards from a point midway between the anterior and posterior superior spines of the ileum.

In most dissecting-rooms the superficial muscles of the back are dissected with the arm. They include

Trapezius.
Latissimus dorsi.
Rhomboids.
Levator anguli scapulæ.

All of them are muscles acting on the scapula. The method of exposing them has already been described with the arm, and as in removing the upper

limb they have all been cut away, they may be dismissed without further remark. The deeper muscles of the back are as follows :

Serratus posticus, superior and inferior.
Muscles at the back of the neck, viz.:
- Splenius.
- Trachelo-mastoid.
- Complexus and biventer cervicis.
- Levator anguli scapulæ.
- Semispinalis colli.

Muscles of suboccipital triangle, viz.:
- Superior oblique.
- Inferior oblique.
- Rectus capitis posticus major.
- Rectus capitis posticus minor.

At the junction of the cervical with the dorsal, and the dorsal with the lumbar regions, a thin and broad band of muscular fibres may be seen running to the angles of the ribs. These are the serratus posticus, superior and inferior. They should be cleaned, divided near their spinal attachment, and turned outwards. It is sometimes difficult to determine the exact width of these muscles, because a layer of fascia, sometimes called the vertebral aponeurosis, stretches from the superior to the inferior. This aponeurosis or fascia is attached to the spines of the vertebræ internally, and to the angles of the ribs externally. It is frequently attached to the sheath of the latissimus dorsi below, and above it sends a thin prolongation under the splenius, to become continuous with its sheath.

The splenius may now be cleaned from origin to insertion. That part of the muscle which is attached to the mastoid process and superior curved line (splenius capitis) should be done first. The muscles of opposite sides will be found to diverge above, and in the triangular interval between them the complexus can be seen. This portion of complexus may be cleaned, but in doing so care must be taken not to cut away the great occipital nerve which pierces it.

The splenius colli consists of about three or four

slips, which are given off from the outer edge of the splenius to the atlas, axis, and third and fourth cervical vertebræ, as it passes them. The levator anguli scapulæ arises from the same vertebra, in front of the splenius colli. It has already been partially cleaned; it may now be completed, and if not already reflected, it should be cut through about an inch from its scapular attachment. Its upper end may be lifted up in order to see the nerve to the rhomboid muscles and the posterior scapular artery, which lie beneath it. High up, branches of the deep cervical plexus may be traced into the levator anguli scapulæ; lower down, the nerve to the rhomboid gives a twig to it. The splenius should be reflected in order to expose the complexus, and the trachelo-mastoid which lies between them. The splenius should be divided close to its spinal attachment, and turned outwards.

In dividing a flat muscle like this it will usually be found convenient to push a flat director, or the handle of a knife, beneath it, and then to cut down upon this guide. The occipital attachment of the splenius should be divided in a similar manner. The occipital artery lies just beneath, so that caution is requisite in cutting through it.

The fascia beneath the splenius should be removed, and the trachelo-mastoid cleaned. Afterwards the complexus and its inner part, which is called the biventer cervicis, made out from origin to insertion. The appearance of the double-bellied biventer is very typical, and readily enables the student to ascertain his whereabouts. A small artery is usually seen (superficial branch of princeps cervicis) winding round the upper and outer border of the complexus, to end between it and the splenius. The posterior divisions of the cervical nerves which pierce the complexus and splenius should be preserved as much as possible. The complexus should be divided where the great occipital

nerve pierces it, a little below the occipital bone, and its ends turned upwards and downwards. This must be done without injuring the great occipital nerve. Beneath the complexus is a quantity of very dense connective tissue and fat, beneath which the following should be found :

Suboccipital triangle and contents.	Semispinalis colli muscle.
Princeps cervicis, and	Posterior divisions of cervical nerves.
Profunda cervicis arteries.	

The suboccipital triangle may be dissected first. In many dissecting-rooms the body is not turned over long enough to allow the suboccipital triangle to be dissected. Under these circumstances it may be left until convenient. But if the dissection be continued the triangle will be found situated immediately beneath the occipital bone, so that in order to expose it easily the head requires to be bent well forwards. The triangle is not of any great size, and is bounded by the muscles which rotate the head, viz., superior oblique, inferior oblique, and rectus capitis posticus major. The rectus capitis posticus minor is just outside the triangle, nearer the middle line. Before attempting to make out the boundaries of the triangle, the positions of the bony points to which the muscles are attached should be ascertained. In the middle line, and a little below the occipital bone, the spine of the axis must be felt, and the removal of the connective tissue may be begun at its situation. (The principal insertion of the semispinalis colli marks this prominence with great clearness.) The end of the transverse process of the atlas should be felt for, lying beneath the mastoid process, and extending nearly as far out as its tip.

The usual plan is to be followed in dissecting this space : first, to define its boundaries, and then make

out its contents. Its boundaries have been mentioned; its contents are the vertebral artery and suboccipital nerve, which lie in a quantity of fat and connective tissue. Its floor is formed by the atlas and posterior occipito-atloid ligament. The head should now be strongly rotated, so that the mastoid process of the side which is being done may be turned as far as possible from the spine of the axis. This movement makes the inferior and superior oblique muscles tense. The inferior oblique may now be cleaned by beginning at the spine of the axis and tracing it outwards. Particular care must be taken, as the lower border is followed, not to divide the great occipital nerve which winds round it. When the great occipital nerve has been found, it may be gently lifted up in order to display a twig which it sends into the inferior oblique. This branch, or a separate one, communicates with the suboccipital nerve. The great occipital nerve may be traced through the complexus, and the whole of its distribution gone over. If it is followed beneath the inferior oblique, it will be seen to emerge between the posterior arch of the atlas and lamina of the axis, piercing the posterior atlo-axoid ligament. Where it lies upon the axis, there is a ganglion upon the nerve (ganglion of posterior root), and, external to this, the division of the trunk of the nerve into the great occipital, already seen, and into anterior division, should be made out. This dissection may with advantage be postponed for a little while, for later on there will be no difficulty in tracing the anterior division round the vertebral artery to the front of the neck.

The occipital artery should now be found emerging from beneath the mastoid process. Just as it emerges it gives off a long and slender branch, called the princeps cervicis. The princeps cervicis divides usually into a branch which passes over, and a branch which passes beneath, the complexus. The

former has been dissected. The latter may now be followed downwards upon the semispinalis colli to anastomose with an artery (profunda cervicis) which ascends from the superior intercostal. The princeps cervicis must be drawn aside, and the superior oblique cleaned; it is attached just below and behind the mastoid process. The occipital artery lies upon its upper part, but has already been cleaned. The superior oblique should be traced to the transverse process of the atlas. The rectus capitis posticus major may be traced upwards from the spine of the axis to its attachment to the occipital bone, and beneath its inner edge the rectus capitis posticus minor should be found and cleaned. Care must be taken, in removing the fat and connective tissue from the suboccipital triangle, not to cut away the suboccipital nerve. If the fat be gradually removed a twig of the nerve is sure to be met with, and being traced into the triangle, will lead to the main trunk. In some subjects this plan may not succeed; the nerves may be soft, and easily broken. When this is the case, the posterior arch of the atlas should be sought for, and followed outwards. Lying in a groove upon its upper surface, and quite externally, is the vertebral artery, and coming out between the bone and artery is the suboccipital nerve. The nerve and artery should be cleaned, and the remaining fat of the triangle removed. The suboccipital nerve should next be followed a little way beneath the vertebral artery. It will be found to give off a large branch, not easily seen, which winds outwards round the articular process of the atlas to get to the front of the vertebral column. In its passage forwards it goes between, first, the vertebral artery and articular process; second, the rectus capitis anticus minor and the rectus lateralis. It then loops down in front of the atlas to join the anterior *division* of the second nerve. In its course it may

be seen to give off branches to all the parts with which it is in contact, viz., the sympathetic around the vertebral artery, the occipito-atloid articulation, rectus lateralis, and rectus anticus minor. The loop which it forms with the second nerve will be dissected with the nerves at the base of the skull. (*Vide* page 283.) The student is recommended to remember the course of the suboccipital nerve over the atlas, and to dissect it later on. The posterior branch of the suboccipital nerve, the one seen in the triangle, gives off branches to all the muscles of the triangle, and to the complexus. These branches should be carefully dissected.

The profunda cervicis artery may now be traced round the outer border of the semispinalis colli, to disappear below the scalene muscles. Its origin from the superior intercostal artery will be exposed later on. The semispinalis colli should be cleaned. This muscle may be seen converging principally to the spine of the axis, and, to a lesser extent, to the spines of the other cervical vertebræ; from these points its fibres may be traced down to the transverse processes of the upper dorsal and lower cervical vertebræ. The lower cervical nerves, viz., third, fourth, fifth, sixth, seventh, and eighth, send branches backwards to supply the muscles and skin at the back of the neck. Many of them have already been seen piercing the muscles. Sometimes the upper ones communicate beneath the complexus to form a plexus, the posterior cervical plexus of Cruveilhier.

Dissection of the deep muscles of the back.—At each side of the lower part of the spinal column, and beginning from the pelvis, is a very large and powerful muscle. Below, the mass of muscle is attached to the pelvis; but above, in the dorsal region, it divides into an outer and inner bundle. Traced from below, the muscles of the back will be seen gradually to diminish in size. The single muscle

below is called the erector spinæ, and the two bundles into which it divides are called the longissimus dorsi and sacro-lumbalis. The continuations of these muscles have names assigned to them, but their names and arrangements are best shown in the following scheme (Fig. 39), which is copied from Holden's "Osteology."

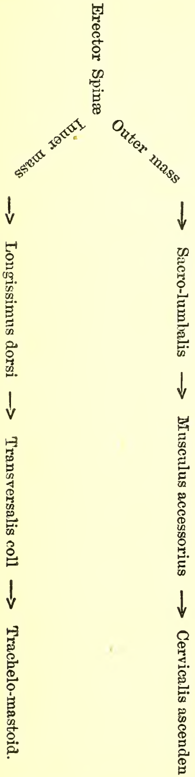


Fig. 39. — Scheme of Muscles of the Back.

The erector spinæ is covered in with an exceedingly dense sheath of fascia, called the lumbar aponeurosis. This aponeurosis is derived from the transversalis muscle of the abdomen in the following manner.

The fibres of the transversalis end, just external to the transverse processes, in an aponeurosis, which splits into three divisions. The most posterior passes over the back of the erector spinæ, to be attached to the lumbar spines. This is the portion which is in view. The middle part of the aponeurosis goes in front of the anterior edge of the erector spinæ to the tips of the transverse processes. The anterior division is in front of the quadratus lumborum, and goes to the front of the transverse processes of the lumbar vertebræ (Fig. 16). Below, the lumbar aponeurosis is attached to the pelvis; above, it is continued in a thin layer for

some distance up the back, on the surface of the deep muscles, blending with the lumbar fascia previously mentioned. To display the sheaths which the transversalis aponeurosis makes, the latissimus dorsi having been previously removed, and the obliquus externus muscle having been cut from its attachments to the ribs and ileum and turned forwards, the fibres of the internal oblique muscle of the abdomen are brought into view, running upwards to be attached to the sheath of the erector spinæ.* They are to be carefully cleaned away from the sheath, until the fibres of the transversalis muscle are seen running, as its name implies, transversely. The fibres of the transversalis will be seen to end in the aponeurosis. The sheath of the erector spinæ should now be opened by a vertical cut near the outer margin of the muscle. The handle of the knife should be pushed outwards to show its outer limits, and the outer edge of the muscle raised to display the front of the sheath.

The aponeurosis may now be divided external to the muscle, in order to display the outer edge of the quadratus lumborum from behind. The finger should be pushed into the abdomen to feel the lower edge of the kidney, if it has not been removed, and afterwards the fat may be removed to show the relation of the colon to the outer edge of the quadratus lumborum. The vessels and nerves of this region will have been dissected by the student who is dissecting the abdomen.

The fascia may now be reflected from the posterior surface of the erector spinæ, and the two divisions of the muscle made out. The line of separation between the outer and inner bundle of muscles is defined by the posterior divisions of the dorsal nerves, and branches of the intercostal arteries which emerge

* The abdominal muscles will have been, by this time, removed by the dissector of the abdomen.

between them. The nerves should be looked for, and when they are found the muscles may be defined. As far as the origins and insertions of these muscles are concerned, it will be found that they vary very much. Roughly speaking, most of the muscles may be said to be attached to an equal number of ribs or vertebræ, both at their origin and insertion. Those in the upper dorsal and lower cervical region are nearly all of them attached to half the dorsal and half the cervical vertebræ.

When the muscles of the back have been sufficiently dissected, the smaller muscles of the vertebral column may be examined. The muscles which have been already studied should be removed, and then the most important of the small muscles made out. These are the levatores costarum, which should be cleaned from the tip of the transverse process above to the margin of the rib below. It is only necessary to clean one or two of these muscles. Other muscular fibres will be seen running from one point to another on the vertebræ (multifidus spinæ), some from spine to spine, others from spine to transverse processes, and others between the transverse processes. These fibres may be made out in the lower region of the spine, where they form a considerable mass underlying the erector, which must be divided below and turned outwards to expose them.

Separation of the larynx and pharynx, and front of the skull, from the spine and back part of skull.—It will usually be found most convenient at this time to pass on to the dissection of the larynx and pharynx rather than the spinal cord. In most dissecting-rooms the body does not remain upon its belly a sufficient time to permit the spinal cord to be dissected at such an early stage, but if it has been injected with spirit it will keep in good condition. In order to remove the larynx and pharynx it is

necessary to divide all the structures in front of the lower cervical spine about an inch above the sternum. The muscles and veins in front of the trachea may be divided first. They are the sterno-hyoid and sterno-thyroid muscles, and inferior thyroid veins. The common carotid artery, internal jugular veins, and pneumo-gastric, sympathetic, and cardiac nerves, should be cut through at the same level. Next, the inferior thyroid arteries and veins, and recurrent laryngeal nerves should be severed. All the parts which have been divided may now be pulled well away from the spine, and the occipital arteries divided about half an inch from the external ear.

Still pulling the larynx and pharynx and other structures forwards, the communications of the cervical plexus with the cranial and sympathetic nerves should be divided. Afterwards the hypoglossals may be cut through close to the anterior condyloid foramen, and the cellular tissue, which is found between the vertebral column and the back of the pharynx, torn through with the back of the knife and finger of the dissector. Near the base of the skull it may be difficult to keep all the great nerves and veins upon the anterior portion; but wherever they are not separated from the posterior portion, the knife may be brought into careful use.

The larynx, etc., should now be drawn strongly forward over the face, and the handle of the knife pushed upwards behind the median raphé of the pharynx, until the basilar process is almost exposed. The next step is to divide the basilar process, and this may be done in the following way. The remains of the body may be inverted, so that the upper surface of the base of the skull rests upon the floor. A broad chisel, such as was used for opening the skull, should be pushed against the back part of the basilar process, and pointed a little backwards. A blow with a

hammer will easily drive the chisel through the cancellous basilar process. Any remaining attachments may be cut through, and the parts separated.

Dissection of prevertebral region. Neck. —The anterior detached part should be wrapped up in a damp cloth and guttapercha tissue, and kept for examination. The superior aperture of the thorax, if not already dissected, and the vessels and nerves more particularly belonging to it, still form part of the posterior portion. Upon it the following parts require dissection:

Prevertebral muscles (longus colli, rectus capitis anticus major and minor).	Vertebral artery and vein.
Scalene muscles.	Spinal nerves (cervical).
	Profunda cervicis artery.

No particular directions are required for the dissection of the rectus capitis anticus major and minor, and longus colli. They are merely to be cleaned from origin to insertion. The dissection of the superior intercostal artery was performed with that of the superior aperture of the thorax, and the greater part of its important branch, the profunda cervicis, was dissected with the back of the neck. It still remains to trace the profunda, beneath the scalenus medius and posticus, to the back. The scaleni should therefore be completed; the nerves which pierce the medius, viz., nerve of Bell and nerve to rhomboids, have already been seen. They may at this stage be traced through the muscle to their point of origin. To expose the profunda beneath the scalene muscle, the trunk of the artery, as it appears behind, will serve as a guide, and the muscle fibres should be cut through transversely, until the artery goes under the tranverse process of the seventh cervical vertebra. The transverse process may now be removed with bone forceps, and the artery cleaned

as far as the superior intercostal. The vein which accompanies the artery may occasionally be made out. A number of short muscular fibres will be seen extending from the front and back edge of one transverse process to the transverse process above and below. These intertransverse muscles should be cleaned, and those in front removed, in order that the contents of the vertebral canal may be exposed. To do this completely, the anterior portions of the transverse processes, from the second to the sixth, should be removed with bone forceps. In the canal is the vertebral vein in front, and behind it the artery, with the sympathetic surrounding it. The cervical nerves, third, fourth, fifth, and sixth, lie in grooves upon the upper surfaces of the transverse processes. They pass out of the spinal canal transversely, going behind the vertebral artery and vein. The seventh and eighth pass out in a similar manner, but of course are not in relation with the vertebral artery, which enters the canal at the sixth vertebra. The attention of the student may be again directed to the first and second cervical nerves, and he should see how they differ from the others. There is one portion of the suboccipital nerve which has not been clearly exposed; this is the part of the anterior branch which crosses over the atlas. This may be exposed by carefully dividing the rectus lateralis from the outside, keeping the nerve itself well in view. By making the nerve tense with the forceps, its course will become apparent, and it may be separated from the connective tissue in which it lies. Behind, it disappears beneath the vertebral artery. The anterior branch of the suboccipital differs from the anterior branches of the other cervical nerves, because it winds round inside the vertebral artery, and not round its outside.

CHAPTER X.

DISSECTION OF THE PHARYNX, LARYNX, AND TONGUE.

Structures seen during its Dissection.

Arteries:
- Ascending pharyngeal.
- Tonsilar.
- Ascending palatine.

Pharyngeal plexus.
Constrictors of pharynx.
Stylo-pharyngeus.
Œsophagus.
Sinus of Morgagni.
Pharyngeal aponeurosis.
Posterior nares, and other openings into pharynx.
Pillars of fauces.
Tonsils.
Back of tongue.

When the pharynx, œsophagus, and larynx have been separated from the vertebral column in the manner which has just been described, they will be more readily available for dissection.

The œsophagus and pharynx must be carefully stuffed with tow, either through the mouth or œsophagus, so as to distend them, and make their walls tense and easy to dissect.

The skull must be placed face downwards, and secured by string or hooks to a block, and likewise the lower end of the cut œsophagus and larynx; or they can be nailed to the block, after being firmly stretched.

Before the pharynx itself is dissected, it is best to make out the pharyngeal plexus of nerves which lies on its outer surface.

In close contact, too, with its walls are some arteries, but as they lie partly in and partly outside the pharynx, their dissection must be deferred till the pharynx is opened. The student must not forget their existence, or they will be cut away during the dissection of the nerve plexus.

In order to display this, the glosso-pharyngeal nerve must be looked for; one or more branches (the pharyngeal) will be found coming off from it high up, and can be traced to the side of the pharynx. To about the same situation, a branch or two can be traced from the ganglion of the trunk of the vagus. These nerves can be shown by a little dissection to form a plexus, which in a very good body can be seen to receive branches also from the sympathetic, and sometimes from the superior laryngeal nerve.

From this plexus, or from the glosso-pharyngeal nerve itself, branches can be traced, with a little care, to the constrictors and stylo-pharyngeus, and, *it is said*, to the palato-glossus and palato-pharyngeus.

Amongst the branches of this plexus are numerous veins, which have been alluded to at an earlier stage of the dissection as the pharyngeal plexus of veins, which usually open into the internal jugular.

Covering over the pharynx will be seen a very thin layer of connective tissue, which is derived from the deep cervical fascia. It must be carefully cleaned off, so as to expose the underlying muscles (the constrictors) which form the wall of the pharynx. If the student begins to dissect the constrictors near the pharyngeal spine, and works downwards, when he arrives about at the level of the lower jaw he will find that he is getting into the wall of the pharynx, instead of keeping on the outside. The reason of this is, that the pharynx is surrounded not by one constrictor muscle, but by three; the lowest of the three overlaps the middle, and the middle the superior, and it is in between the middle and superior that the student will find himself dissecting, if he does not take care. The stylo-pharyngeus muscle also separates the middle and superior constrictors.

About an inch and a half lower he will find the inferior constrictor, which terminates at the level of

the cricoid cartilage by joining the œsophagus. The line of their junction is generally very clearly indicated by a change in the direction of the muscular fibres.

The œsophagus fibres are much the same colour as those of the constrictors, and for some distance down the œsophagus they consist of true striped muscle.

When the constrictors have been thoroughly cleaned, their exact origins must be very carefully made out, and for this purpose it is essential to have a skull at hand, so as to make out the origin of the superior constrictor from the back edges of the bony walls of the nose, as well as from the pterygo-maxillary ligament and lower jaw.

By following up the fibres of the superior constrictor, the student will find that just as there is a free edge below to this muscle, so likewise there is one above, and consequently there is a space between this muscle and the under surface of the skull, except at its insertion into the pharyngeal spine. This space is called the sinus of Morgagni, and transmits the levator palati muscle, the Eustachian tube, and branches of the ascending pharyngeal artery.

When the superior constrictor is completed, the middle and inferior can be also made out and learnt. Their origins from the hyoid bone, thyroid and cricoid cartilages, etc., will easily be seen.

Between the superior and middle constrictors are situated, as has been already stated, the stylopharyngeus muscle, and between the middle and inferior the superior laryngeal nerve, which has been dissected at a much earlier stage.

To display the inside of the pharynx an incision must be made down the median raphé of the constrictors, and continued down to the lower end of the piece of œsophagus which the student has before him. Great care must be taken to cut only the muscular

fibres, for underlying them will be seen a dense fibrous membrane, which is more abundant at the upper part of the pharynx, and can be very clearly seen through the sinus of Morgagni attaching the pharynx to the base of the skull, so that it is evident that it is only the muscular wall of the pharynx which is absent at the sinus of Morgagni, and not the fibrous or mucous layers. Next, remove the muscular fibres from the pharynx, and display the fibrous membrane (the pharyngeal aponeurosis).

When its attachments have been made out, it must be divided down the middle line along with its subjacent mucous membrane. The inside of the pharynx will then be displayed, and the tow which is contained in its interior must be all removed.

The arteries which supply the pharynx, viz., the ascending palatine, tonsilar, and ascending pharyngeal, must next be traced to their destination. They have already been seen and dissected at their starting-points.

The ascending palatine, if injected, will be easily traced upwards, passing between the stylo-glossus and stylo-pharyngeus. After sending some branches to all the parts with which it is in contact, two larger branches can be traced; one perforates the superior constrictor to reach the tonsil, whilst the other is continued up to the sinus of Morgagni at the upper border of the superior constrictor, and, accompanying the levator palati, will be seen inside the pharynx to enter the soft palate. This and the succeeding branches can usually be seen under the mucous membrane of the pharynx before it is removed.

The tonsilar branch can be traced up to perforate the superior constrictor, and supply the tonsils.

The ascending pharyngeal, coming off from the back of the external carotid, lies on the side of the pharynx, and, supplying all the muscles of the pharynx

and of the front of the vertebral column, together with the glands of this region, perforates the constrictor to supply the mucous membrane of the pharynx, Eustachian tube, and tonsil.

It also gives off three sets of meningeal branches, which are often difficult to trace, as they are sometimes not injected. They perforate the foramen lacerum medium and posticum, and the anterior condyloid foramen.

The student will do well to remember that these three arteries, ascending pharyngeal, ascending palatine, and tonsilar, vary much in size and distribution, as one often takes the place of the other.

The pharynx should now be opened by an incision along the middle of its posterior surface (median raphé).

With the skull still before him, the student must carefully study the cavity of the pharynx. The posterior nares, mouth, pharynx, and œsophagus, will be at once presented to his view. On the outer side of the posterior nares, and coming through the sinus of Morgagni, will be seen the funnel-shaped orifice of the Eustachian tube, with a small hole, perhaps a sixteenth of an inch in diameter, in its centre, leading up to the middle ear. The size, situation, shape, and relations of the openings into the pharynx must be carefully studied. Guarding the opening into the mouth, two folds of mucous membrane will be seen on each side, one in front, passing from the palate to the side of the tongue, and another behind, passing down to the pharynx. These are called respectively the anterior and posterior pillars of the fauces; in the depression between them are situated the tonsils, the surfaces of which are marked by a series of pits. The tonsils and pillars of the fauces should be carefully studied, by the aid of a looking-glass, in the student's own body, so that he may become familiar with them under all conditions.

Higher up the pharynx, in the neighbourhood of the sinus of Morgagni, will be seen a depression in the mucous membrane, in which a structure similar in appearance to the tonsils is seen. The pits which have been before described in connection with the tonsils are very readily seen in this structure, which has therefore received the name of the tonsil of the pharynx.

When the inside of the pharynx has been well studied, the student must for a moment turn to consider its formation and shape, as it is not at first by any means easy to appreciate its exact relation and attachments.

But these will not be so difficult to realise if the student will bear in mind that the pharynx is a tube without any front wall. Its sides and back are formed by the constrictors, but there is a hole in front to bring it into connection with the mouth, and consequently the buccinator is made continuous with the superior constrictor by means of the pterygo-maxillary ligament.

This ligament can be very readily felt in the student's own mouth as a vertical band, if he pass his finger back about half an inch behind the ascending ramus of the lower jaw.

In order to dissect the inside of the pharynx, the mucous membrane and pharyngeal aponeurosis must be removed. As this is being done, the stylo-pharyngeus will be seen passing downwards, and its fibres must be traced to their destination on the back of the thyroid cartilage and pharyngeal aponeurosis.

THE PALATE.

Structures seen in the Dissection of the Palate.

Azygos uvulæ.	Palato-pharyngeus.
Levator palati.	Tensor palati.
Eustachian tube.	Palato-glossus.

In order to display the various constituents of the palate, and understand their relationship, an incision must be made through the mucous membrane of the palate along the middle line, the palate itself having been first made tense with hooks. When the mucous membrane has been removed, the muscles of the palate will be displayed. In the middle line running down the uvula, will be seen the azygos uvulæ. Coming down through the sinus of Morgagni, just behind the Eustachian tube, are the fibres of the levator palati. In order to display it, pull the palate to the opposite side, when the outline of the muscle will be seen through the mucous membrane.

It should be traced upwards as far as the Eustachian tube and temporal bone; below, it must be followed down into the palate. The palate must next be pulled upwards, when the posterior pillar of the fauces will be rendered tense, and only requires to have its mucous membrane removed, to display the palato-pharyngeus which is contained in it. Trace the fibres downwards till they are lost in the wall of the pharynx, and upwards so as to display their insertion into the palate. The insertion consists of two bundles, separated by the levator palati.

To display the tensor palati winding round the hamular process, a search must be made outside the superior constrictor. The tensor palati lies between the internal pterygoid muscle and the internal pterygoid plate; and if the connective tissue in this situation be removed by vertical incisions, the muscle will be cleaned to where its tendon winds round the hamular process. If tension be exerted upon this muscle from the outside of the pharynx, and the palate at the same time be lifted up and pulled to the opposite side, the direction of its reflected tendon may be displayed, and the tendon can be traced to its insertion.

If branches of the ascending palatine and pharyngeal arteries get in the way in the first part of the dissection, they must be removed.

In order completely to display the palato-glossus fibres, pull the palate to the opposite side, and clean the mucous membrane from the anterior pillar of the fauces, tracing its fibres upwards into the palate, and downwards into the tongue.

The branch from the otic ganglion to the tensor palati can sometimes be found entering the muscle on its outer surface, if the body is a good one, but the nerves to the other palate muscles are rarely if ever seen without special preparation.

The **larynx:** its appearance before dissection; its movements, and their effects upon the vocal cords and glottis.—When the pharynx has been completed, the larynx will be brought into view. Remove with a pair of scissors the tongue, and what remains of the pharynx, from their attachments to the lower jaw and skull, cutting close to the bone. The larynx will of course be removed with the tongue, and will now be easy to manipulate.

Its construction must be studied before any attempt is made to dissect it. It is advisable, if possible, that the student should first examine a dried larynx; just as he examines the bones, and learns the muscular attachments upon them, before attempting any dissection whatsoever.

Whether he has been able to study a dried larynx or not, by this time the hyoid bone, thyroid and cricoid cartilages, and the epiglottis will have been recognised.

If all the remains of the pharynx and œsophagus have not been removed from the larynx behind, they must be carefully dissected off, great care being taken not to injure the muscles which lie on the cricoid cartilage behind, or the recurrent laryngeal nerve,

which lies just internal to the posterior cornu of the thyroid cartilage, and has been seen, long before the pharynx was separated from the vertebral column, running up by the side of the œsophagus.

Situated on the top of the cricoid cartilage behind, will be seen two small pyramid-shaped masses covered with mucous membrane. These are the arytenoid cartilages; and running forward from them to the sides of the epiglottis are two folds of mucous membrane, the aryteno-epiglottidean. The space between these folds is termed the upper aperture of the larynx.

In front of the epiglottis, and connecting it with the tongue, are three folds of mucous membrane, one in the middle, and one on either side called the glosso-epiglottidean folds.

If the student looks into the upper aperture of the larynx, he will see two bands on each side, separated by a small cavity, the ventricle of the larynx. These bands are the superior (false) and the inferior (true) vocal cords, which latter are concerned in the production of the voice sounds. The true vocal cords can be made to diverge or come into close contact at will, and can likewise be rendered lax or tense. These movements can easily be shown in the following manner.

If the cricoid cartilage and trachea are firmly grasped in one hand, the thyroid can be made to move up and down over the front edge of the cricoid, its lower angle behind, where it articulates with the cricoid, acting as the hinge. As the thyroid cartilage moves down over the cricoid in front, the true vocal cords will be seen to become tense, whilst movement in the opposite direction renders them lax.

This action is effected by the crico-thyroid muscle in front, which has probably been dissected before with the front of the neck. If not, it will be readily discovered stretching on each side of the thyroid cartilage from it to the cricoid, and must be cleaned.

In between the muscles of the two sides will be seen an elastic membrane (crico-thyroid), which unites the cricoid to the thyroid cartilage in front.

The approximation and the divergence of the vocal cords is effected by the rotation movement of the arytenoid cartilages on the cricoid, and can be shown by laying hold of the tip of these cartilages with the

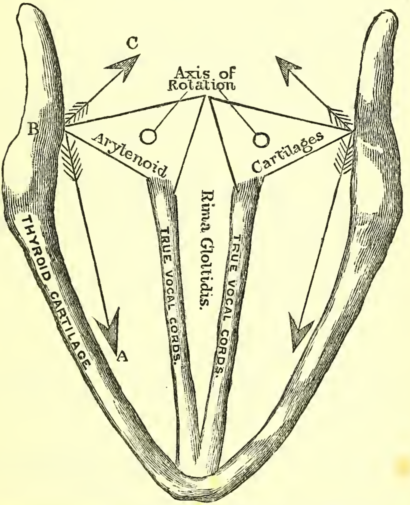


Fig 40.—Illustrating the Movements of the Arytenoid Cartilages.

dissecting forceps, and screwing them slightly towards the right or left. If the student holds the larynx so that he faces its back surface, he will find that rotation of the right arytenoid cartilage towards the right hand, and rotation of the left arytenoid cartilage towards the left hand, will cause the true vocal cords to diverge,

whilst rotation in the contrary direction will cause their approximation. This approximation and divergence of the vocal cords is generally spoken of as closing and opening the glottis (or slit between the true vocal cords).

The student must bear in mind that all the muscles which he is about to dissect are concerned in producing one of the following four movements :

(1) Making the vocal cords tense.
(2) Relaxing the vocal cords.
(3) Approximating the vocal cords.
(4) Causing the vocal cords to diverge.

The movements of the arytenoid cartilages will be better understood by referring to Fig. 40 on the previous page.

The axis of rotation of the arytenoid is supposed to be represented by a vertical line, which is seen in section at O. It will be readily understood that tension along the lines A B will produce an approximation of the vocal cords, whilst tension along the lines B C will give rise to their divergence.

DISSECTION OF THE LARYNX.

The following structures will be met with in the dissection of the larynx :

Muscles :
- Crico-thyroid.
- Arytænoideus.
- Crico-arytænoideus posticus.
- Crico-arytænoideus lateralis.
- Thyro-arytænoideus.
- Aryteno-epiglottideus superior.
- Aryteno-epiglottideus inferior.
- Thyro-epiglottideus.

Vessels :
- Superior laryngeal artery and vein.

Nerves :
- Superior and inferior (recurrent) laryngeal nerves.

Ligaments :
- Three crico-thyroid.
- Three crico-arytenoid.
- Three thyro-hyoid.
- One thyro-epiglottic.
- One hyo-epiglottic.

The crico-thyroid muscle has already been dissected from the front. The larynx must be tied or nailed to a block, with its front surface downwards, and its back surface facing the dissector.

Connecting the two arytenoid cartilages behind, and probably exposed during the removal of the pharynx, is the arytænoideus muscle, the fibres of which will be seen to decussate, *i.e.*, cross each other very abundantly.

Immediately below this muscle, situated on the back of the cricoid cartilage, are two muscles, one on each side, the crico-arytænoidei postici. These muscles pass up to the posterior and outer angles of the arytenoid cartilages.

If these muscles have not been already dissected, they must be carefully cleaned.

One half of the thyroid cartilage must now be removed, by dividing it just to the side of its projecting angle in front (the pomum Adami), and cutting it away from its attachment to the cricoid. Any other structures which still hold it can then be cut through close to the cartilage. Whilst doing so, look for the crico-thyroid muscle on its outer surface, and see that this muscle is partially attached to its lower border and inner side.

If the handle of the knife be inserted into the ventricle of larynx on that side from which the thyroid cartilage has been removed, its extent and direction will be easily made out.

Just in front of the insertion of the crico-arytænoideus posticus, the crico-arytænoideus lateralis will be discovered. Its fibres must be traced downwards and forwards.

Just above the crico-arytænoideus lateralis, and contained in the aryteno-epiglottic folds above the ventricle, are some muscular fibres, which will be seen, when the mucous membrane is removed, stretching

from the epiglottis to the thyroid and arytenoid cartilages, and coursing in various directions.

Usually in a dissecting-room body these fibres are so pale as to be scarcely visible; but they have been described as consisting of three muscles, the thyro-epiglottideus, and aryteno-epiglottideus superior and inferior.

On the outer side, and rather below the ventricle, are muscular fibres, stretching from the thyroid cartilage to the arytenoid (thyro-arytænoideus). These usually consist of several fasciculi, running in different directions, and can be easily made out after the removal of one half of the thyroid cartilage.

The muscle can also be readily made out from the inside of the larynx, after it has been cut in two by dividing the thyroid cartilage in front, and the cricoid in front and behind, as well as the soft parts. In order to see it, the mucous membrane must be removed just below the true vocal cords, and the side of the crico-thyroid membrane cut away where it passes up to become continuous with the vocal cords, when the fibres of the muscles will be at once displayed.

The superior laryngeal artery, which has been traced to the thyro-hyoid membrane from the outside, will be seen breaking up into numerous small unnamed branches after piercing that membrane, and is accompanied by some branches of the superior laryngeal nerve.

The recurrent laryngeal, which was seen, during the dissection of the pharynx, to pass under the inferior constrictor, can now be traced very easily, if gentle traction is exerted upon it, under the crico-arytænoideus posticus. Underneath this muscle it divides into branches, which enter the deep surface of all the rest of the muscles, except the crico-thyroid.

The arytænoideus is supplied by both superior and inferior laryngeal nerves, which effect a junction in its substance ; but this can rarely, if ever, be traced in a dissecting-room body.

In a carefully-prepared and hardened larynx, a skilful dissector will make out three communications between the superior and inferior laryngeal nerves.

(1) In the arytænoideus.
(2) On the back of the cricoid cartilage, superficial to the muscles.
(3) Immediately beneath the ala of the thyroid cartilage.

Ligaments of larynx.—If the crico-thyroid membrane be traced upwards, on the side of the larynx from which one-half of the thyroid cartilage has been removed, it will be found, when the thyro-arytænoideus is cut away from its outer surface, to become continous with the true vocal cords, and to be attached only just in front to the thyroid cartilage. That it is not attached to the side of the thyroid can be readily proved, by pushing the handle of the knife between the cricoid and thyroid cartilages on the side where the thyroid cartilage remains intact. Behind, at the inferior angle, where the thyroid touches the cricoid, there will be seen to be a smooth facet on the cricoid on that side where the thyroid is removed. If the thyroid cartilage be bent over towards the other side, and a little cleaning effected where it articulates with the cricoid, a capsular ligament will be made out, and when cut into will display the joint.

By divesting the arytenoid cartilage of all muscle and connective tissue, and moving it about with the forceps, the loose capsular ligament which attaches it to the cricoid will be readily seen, and should be opened. On its back surface the capsule has a fibrous thickening, which sometimes is spoken of as a separate ligament.

On the tops of the arytenoid cartilages, two separate little pieces of cartilage will probably be seen (the cornicula laryngis). They lie in the aryteno-epiglottidean folds, and have already been felt before the mucous membrane was removed.

Passing upwards from the top edge of the thyroid cartilage to the under and back surface of the hyoid bone, is the thyro-hyoid membrane, already well seen and cleaned. Connecting the tips of the thyroid cartilage with the tips of the great corona of the hyoid, a stout fibrous band can be seen, containing the cartilago-triticea, which is generally unequally developed on the two sides. These fibrous bands are only the posterior borders of the thyro-hyoid membrane, but are called the posterior thyro-hyoid ligaments.

Lastly, if the epiglottis be carefully divested of its mucous membrane, there will be seen the two fibrous bands which connect it with the thyroid cartilage and hyoid bones respectively.

On the upper surface of the epiglottis are some small pits about the size of a pin's head, which lodge small glands.

The **trachea.**—The connective tissue should be dissected off the trachea, so as to display its rings, and the fibrous tissue which unites them to each other and to the larynx.

Behind, the rings will be found to be joined by some unstriped muscular tissue, to which the name musculus trachealis has been given, and when the trachea is opened its mucous lining will be displayed.

The lower part of the trachea and bronchi will be dissected with the lungs in the thorax.

Dissection of the tongue.—After the larynx has been dissected, the tongue still remains for dissection. Many of its most important attachments have been divided, but it still remains fastened to the

hyoid bone below and to the epiglottis behind. The following points require to be made out:

Glosso-epiglottidean folds.	Blood supply.
Foramen cæcum.	Insertion of extrinsic muscles.
Filiform, fungiform, and circumvallate papillæ.	Intrinsic muscles.
Nerve supply.	Median septum.
	Mucous glands.

The glosso-epiglottidean folds are three small processes of mucous membrane, which fasten the tongue to the sides and front of the epiglottis. The smallest and most numerous of the delicate elevations which cover the tongue are called filiform papillæ. Scattered amongst them are some slightly larger, like small mushrooms, called the fungiform. At the back of the tongue are about half a dozen larger and flatter elevations called the circumvallate papillæ. They are arranged like the letter V. Where they diverge there is a pit in the mucous membrane (foramen cæcum). All the nerves which supply the tongue have been found, and only require to be traced to their ultimate destinations. The hypoglossal ends amongst the extrinsic muscles. The glosso-pharyngeal may be traced under the hyo-glossus to the mucous membrane of the dorsum of the tongue behind the circumvallate papillæ. The lingual nerve (gustatory) should be dissected to the mucous membrane of the tip and sides. The lingual artery has been almost altogether dissected. Its terminal branch (the ranine) may be followed almost to the tip by simply dissecting off the mucous membrane. It is accompanied by a vein already traced over the hyo-glossus. The remaining artery of the tongue (dorsalis linguæ) may be traced to the dorsum of the tongue by cutting through more of the attachment of the hyo-glossus. The attachment of the hyo-glossus to the tongue separates two muscles which run along the under surface; these are the stylo-glossus and lingualis. Both have been partially seen. The

mucous membrane, mucous glands, vessels, and nerves should now be removed, and these muscle fibres traced to the tip of the tongue. The intrinsic muscles of the tongue consist of superior and inferior longitudinal bands, separated by very numerous transverse fibres. The superior longitudinal fibres (superior linguales) should be exposed by removing the mucous membrane from the dorsum. The lingualis is the inferior band, and has been already seen. The transverse muscular fibres are best examined by making a transverse section of the organ. A median fibrous septum will be seen in the centre of the tongue, from which the transverse fibres may be said to arise; they are inserted into its sides. Mucous glands are abundant about the under-surface and near the tip of the tongue, and may be met with as the mucous membrane is removed.

CHAPTER XI.

DISSECTION OF THE EAR.

The whole of the pharynx, larynx, and tongue have been removed from the front part of the skull, which now consists of the temporal bone and the bones which bound the nasal cavities. Before detaching the temporal bone completely from the facial bones, the student should obtain a skull, and mark upon it the exact position of the Eustachian tube. Upon the under surface of the base of the skull there is a groove, about an inch long, situated between the greater wing of the sphenoid and petrous portion of the temporal bone. The cartilaginous part of the tube lies in this groove, and moreover indents slightly the posterior edge of the internal pterygoid plate at

which it ends. If he has not already done so, the student should practice the manœuvre of passing a probe up the Eustachian tube. As this does not in any way injure the subject for future dissection, any fresh body may be used. The end of a probe should be bent in a semicircle round the edge of a penny. It should be afterwards pushed along the floor of the nasal cavity, until it touches the back of the pharynx. When it will go no farther backwards, it should be withdrawn about half an inch, and its point turned outwards and slightly upwards. If the point be now pressed outwards towards the external auditory meatus, it will enter the trumpet-shaped orifice of the Eustachian tube. When this is accomplished, the probe can no longer be turned round between the fingers. It will be evident that the direction of the Eustachian tube is in a line drawn from the external auditory meatus to the tip of the nose. It lies behind the superior maxilla.

In the remains of the skull the temporal bone is almost detached. The eighth pair of nerves, carotid artery, and jugular vein (if not already divided), and chorda tympani, should be cut through. The tensor and levator palati may be divided about half an inch from the temporal bone, in order to leave their attachments to the Eustachian tube. The internal carotid and sympathetic may be again divided near the apex of the petrous bone, and the petrosal nerves cut through. The temporal bone may now be pulled out, and any of the fibrous tissue which fills the middle lacerated foramen divided. The dissection of the temporal bone should be conducted in the following stages :

(1) The pinna of ear.
(2) External ear from front.
(3) Tympanum, and Eustachian tube from above and in front.

(4) Internal auditory meatus, and facial nerve from above.

(5) Vestibule and cochlea from above.

The muscles which attach the pinna of the ear to the skull have already been dissected. Its blood

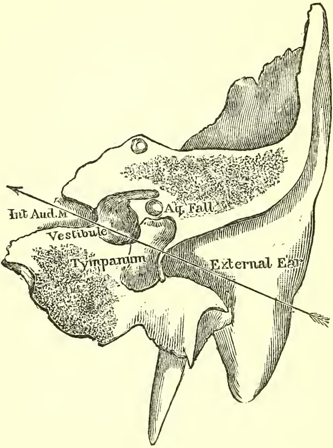


Fig. 41.—Vertical Section of a Temporal Bone.

and nerve supply may be revised, and the names of its different parts learnt. There are numerous bundles of very pale muscular fibres upon its surface, which the student may look for upon a "*fresh*" pinna. Afterwards, any of its muscular and ligamentous attachments which remain may be divided, and the tube of cartilage which passes into the external auditory meatus cut through, and the pinna removed. Before attempting the dissection of the other portions of the organ of hearing, the student will find the

dissection of the part before him much easier if he provides himself with two temporal bones upon which the following sections have been made. If these are not available, the accompanying figures (Figs. 41 and 42) may prove of assistance, but the student should make every effort to obtain the real article.

First, obtain a bone in which a vertical section has been made, extending from within outwards through the centre of the internal auditory meatus

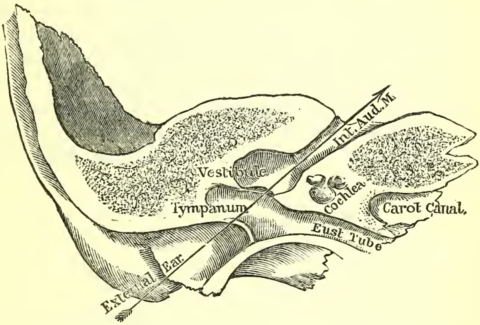


Fig. 42.—Horizontal Section of a Temporal Bone.

and the centre of the external auditory meatus. This section will open, from without inwards, the

(1) External ear.
(2) Middle ear, or tympanum.
(3) Vestibule, part of the internal ear.
(4) The internal auditory canal.

The remaining part of the internal ear, the cochlea, will not be seen, as it is situated in the anterior part of the divided bone, lying with its apex forwards, and its base applied to the end of the internal auditory canal and front of vestibule. The outer and posterior

part of its base, formed by its first turn, protrudes into the middle ear. To show the relations of the cochlea to the other parts of the ear, the second section requires to be made. This is the horizontal one, and should be made horizontally through the centre of the internal auditory meatus and centre of the external auditory meatus. In making these sections, an ordinary fretwork-saw will be found most convenient, and in order to make them the temporal bone should be fixed in a vice. Bristles may now be passed into the Fallopian aqueduct, Eustachian tube, canal for tensor tympani, and, if possible, the canal for Jacobson's nerve. If the student has any difficulty in recognising any of the cavities mentioned above, he should refer to the figures. He should consult his text-book in order to find a minute description of these cavities; but he may remember he has to learn concerning them,

(1) Their relative positions.
(2) Contents.
(3) Openings into them.
(4) Blood-supply.
(5) Nerve-supply.

Having in this way obtained a general view of the dry bones, the student may return to the temporal bone which he has obtained from his part. To examine the external auditory canal, or external ear, the eminentia articularis and glenoid cavity should be cut away with bone forceps, until the Glasserian fissure is reached. When the Glasserian fissure is opened, the small tympanic branch of the internal maxillary artery will be seen, if injected (the chorda tympani, if not too internal), and sometimes a few muscular fibres (laxator tympani) running upwards.* The processus gracilis of the malleus lies in the fissure, but

* Many anatomists regard this as a ligament rather than a muscle.

is not easily seen. The next step is to remove the upper and front part of the auditory process, and a portion of the roof of the external auditory canal, great care being taken not to injure the bone to which the tympanic membrane is attached. Any remains of the cartilage of the pinna and the integuments of the external meatus being cut away, the length and shape of the external ear and the constriction which it presents about its middle, may be examined. The constriction will be found to be due to an elevation of its floor. Next, the outer surface of the tympanic membrane is seen, with the handle of the malleus running down between its layers. The processus brevis of the malleus protrudes into the external ear at the upper part of the membrane, but covered by its outer layer. The biconcave shape and very oblique position of the membrane should be remarked. The middle ear is now to be opened both above and in front. Upon the upper border of the petrous bone, and about half an inch from the squamous portion of the temporal bone, there is an elevation due to the prominence of the superior semicircular canal. As the semicircular canal is, roughly speaking, above the vestibule, its prominence serves to indicate the position of that cavity. It has already been ascertained upon the dried sections that the tympanum lies external to the vestibule, and that it extends some distance farther forward. To remove the roof of the tympanum, the sharp point of the bone forceps should be forced into the bone about one half to three-quarters of an inch in front of the prominence of the semicircular canal. In doing this, great care must be taken lest the forceps slip and injure the contents of the tympanum. If the student begins by drilling a hole, such an accident is less likely to occur. When once a start has been made, the roof of the tympanum may be taken away bit by bit, until the mastoid cells are exposed behind and the Eustachian

tube in front. As the bone is removed from the upper part of the Eustachian tube, the fibres of the tensor tympani muscle are easily seen, and its tendon may be followed into the neck of the malleus. If the muscle be taken hold of with the forceps, it will be seen that the handle of the malleus is pulled inwards, and the membrana tympani made tight. The same movement rotates the incus inwards, and forces the stapes into the fenestra ovalis. These bones, malleus, incus, and stapes, are the chief contents of the tympanic cavity, which also contains the terminations of the muscles which act upon them, viz., tensor tympani, laxator tympani, and stapedius. The first two muscles have been found; the last will be more easily seen later on. Between the handle of the malleus and descending (long) process of the incus, the chorda tympani can be traced crossing from the Glasserian fissure in front towards the back of the tympanum. The remaining contents of the tympanum are, the tympanic plexus of nerves, a number of blood-vessels, and a mucous membrane which lines it, and covers over all the contents which have been mentioned.

Nearly all the boundaries or relations of the tympanum can be made out upon the moist specimen; but whenever the student is at fault he should refer to the dried sections which he has before him.

Outside, the middle ear is separated from the external ear by the tympanic membrane. The inner wall is formed by the cochlea and vestibule. The interval between the outer and inner wall of the tympanum is exceedingly small, and the bulge (promontory) which the turn of the cochlea makes almost touches the tympanic membrane. Owing to this, very little more can at present be seen on this dissection of the cavity; but upon the dried specimens the

following parts are to be recognised upon the inner wall :

Promontory.	Fenestra ovalis.
Grooves on promontory for Jacobson's nerves (tympanic plexus).	Fenestra rotunda.
	Ridge for Fallopian aqueduct.

The remaining relations of the tympanum are, above, a thin plate of bone, which separates it from the cranial cavity. This has been removed. Below are the carotid canal, jugular fossa, and foramen for Jacobson's nerve ; behind, the mastoid cells and promontory ; in front, the Eustachian tube and Glasserian fissure.

The vestibule, cochlea, and Fallopian aqueduct still remain for dissection. If the student desires to attempt to see the contents of the vestibule, viz., utricle, saccule, and membranous semicircular canals, it would be requisite to obtain a fresh temporal bone, and place it in spirit for at least a week, in order to harden the soft parts. After it has been in spirit a sufficient time, it should be placed in dilute nitric or hydrochloric acid, until the bone is well decalcified. A correct idea having previously been obtained from the dry sections as to the positions of the tympanum and vestibule, the decalcified bone may be gradually removed until the membranous labyrinth is exposed.

This procedure is often unsuccessful if attempted upon an ordinary dissecting-room part. In the remaining portion of the temporal bone, the facial nerve should be first dissected, and afterwards the vestibule and cochlea as far as is possible. If it is desired to obtain a more exact knowledge of the vestibule and cochlea, they should be examined on the dry bones, and upon proper microscopic sections made from the ear of a guinea-pig.

Dissection of the aqueduct of Fallopius.—Unless the bone has been soaked in acid, the remaining part of the dissection will present many difficulties. Before beginning to cut the bone away, the course of the facial nerve should be made out upon the dry sections. A thick pig's-bristle can be introduced into any part of the Fallopian aqueduct. This canal begins at the bottom of the internal auditory meatus, and ends at the stylo-mastoid foramen. It contains the facial nerve, and at its termination may be said to contain the stapedius muscle and stylo-mastoid artery. The hiatus Fallopii opens into its commencement, after which it makes a curve round the front and outer side of the vestibule. Whilst making this curve, the canal is horizontal, and makes a ridge on the inner wall of the tympanum just above the fenestra ovalis. After passing over the fenestra ovalis, the aqueduct runs vertically downwards in the posterior wall of the tympanum, to reach the stylo-mastoid foramen. The dissection may be divided into two parts: (*a*) to expose the horizontal portion; (*b*) to expose the vertical. In order to keep the contents of the tympanum intact, and in order to see the stapedius favourably, this dissection may be done in the following manner: The triangular portion of petrous bone which lies between the internal auditory meatus, internally, and a line drawn from the hiatus Fallopii to the hiatus vestibuli, externally, is to be removed with a small saw or with the bone forceps. This lays bare the internal auditory meatus, vestibule, and commencement of the aqueduct of Fallopius. A little more of the aqueduct can be seen if, with the bone forceps, the bit of bone between the hiatus Fallopii and the tympanic cavity has been removed. When this has been done, the facial nerve is seen giving off the petrosal nerves, as it lies in the aqueduct opposite the hiatus Fallopii.

(*Vide* Fig. 43, page 331). At this point it has a slight swelling upon it, called the geniculate ganglion (intumescentia ganglioformis). After the ganglion the facial nerve is seen to turn backwards to pass between the vestibule and tympanum. Its dissection may be continued. Using the bone forceps very carefully, the bone should be removed from the vestibular side of the Fallopian aqueduct, and the nerve exposed. At this stage the end of the stapes can be distinctly seen in the vestibule, looking through the fenestra ovalis. The tensor tympani muscle should again be pulled upon to see what effect it has upon the stapes. The vertical portion of the facial nerve may next be exposed. With the bone forceps the back of the petrous bone should be gradually removed, and the nerve traced down from its horizontal part as far as the stylo-mastoid foramen.

When the canal is freely opened, some muscular fibres (the stapedius) will be seen in it. If the bone over the back and upper part of the tympanum be removed with bone forceps, the small muscle may be seen entering the cavity through the pyramid, and going to be attached to the neck of the stapes. Lower down, the chorda tympani may be seen arising from the facial, and passing through the tympanum between the malleus and incus.

A branch of the facial nerve enters the stapedius as it lies in contact with it, but is not likely to be discovered. The small stylo-mastoid artery, if injected, may be seen running up the aqueduct to enter the tympanum. It anastomoses round the edge of the membrana tympani with the tympanic branch of the internal maxillary artery. If minutely inspected, these vessels can be seen forming a circle around the membrane, and sending branches down the handle of the malleus to supply the middle of the membrane.

There still remains for examination the internal

auditory canal, vestibule and cochlea. The internal auditory meatus can be seen to be far too large for its contents. The extra space is filled with cerebro-spinal fluid. Its contents are:

Dura mater.	Portio-inter-duram et mollem (nerve of Wrisberg).
Arachnoid.	Auditory artery and vein.
Portio mollis.	
Portio dura.	

Unless the temporal bone has been preserved in spirit, the small nerves can hardly be made out. The facial is the highest nerve, and is rounder and whiter than the auditory. The small nerve of Wrisberg lies between them. The auditory artery can be seen, if injected, dividing at the bottom of the meatus into a cochlear and vestibular division. The auditory vein opens into the superior petrosal sinus.

The vestibule contains the greater part of the membranous labyrinth, which, in a very good specimen, may be partially seen. The upper part of the horizontal section of the petrous bone should be looked at, in order to see the two depressions in the roof of the vestibules, and the small apertures of the semicircular canals. It may be seen that their vestibular ends have dilations, called ampullæ. In order to see the cochlea well (upon the moist specimen), more of the petrous bone requires to be removed. It will be remembered that the cochlea lay with its base applied to the front of the end of the internal auditory meatus, and to the front of the vestibule. The intumescentia ganglioformis should therefore be lifted up, and the bone removed with the bone forceps, one blade of the forceps being applied in the internal auditory meatus, the other below and in front, just about the level of the tensor tympani. The petrous bone, being very brittle, will most probably snap off, and leave the cochlea in section. Upon this

section the modiolus and lamina spiralis ossea may be seen, and possibly the scala media. A pocket magnifying glass will be of aid in recognising the scala media.

The student is advised to keep this preparation for frequent reference. However, if he wishes to see the inner wall of the tympanum and the tympanic plexus, it will have to be sacrificed. To expose the tympanic plexus, the incus should be removed. The floor and posterior wall of the tympanum should be sawn through, so as to leave the membrana tympani and malleus upon the external portion; the inner wall of the tympanum and stapes, together with the facial nerve and pyramid, should belong to the inner portion. The promontory may easily be recognised, and upon it the branches of Jacobson's nerve can be seen. Their presence will rather be indicated by the grooves they make on the bone than by the nerve branches themselves. These grooves may be seen leading towards the fenestra ovalis and rotunda, and others in the direction of the ganglion intumescentiaformis. The stapes has already been seen filling the fenestra ovalis. The fenestra rotundum, which is greatly concealed by the promontory, is not quite so easy to see; it is filled in by a membrane, the membrana tympani secundaria, which separates the cochlea from the tympanum.

CHAPTER XII.

DISSECTION OF THE NASAL CAVITIES, MECKEL'S GANGLION, AND SUPERIOR MAXILLARY NERVE.

The bones which surround the nasal cavities still remain intact. Before making any sections through them, the shape and size and boundaries of the

apertures (anterior and posterior nares) which lead into them should be carefully ascertained. When this has been done, a vertical section must be made with a saw on one side of the septum of the nose. If two students are dissecting, it is to be remembered that the sections are for their mutual benefit. Above, the saw-cut should pass by the side of the crista galli, and backwards through the body of the sphenoid, to emerge at the side of the posterior edge of the vomer. In front, the saw-cut passes through one of the nasal bones into the anterior nares. The soft palate should be divided behind with knife or scissors, and then the hard palate sawn through on the same side of the septum as the cut above. Upon one side of the section the septum of the nose is to be dissected, upon the other the outer wall of the nose and Meckel's ganglion.

Upon the septum the following parts are to be examined:

The septal cartilage.
Septal branch of naso-palatine nerve.
Septal branch of naso-palatine artery.
Septal branch of nasal nerve.

If well injected, the septal artery is seen coursing beneath the mucous membrane, from the upper and back part of the septum to the anterior palatine foramen. The septal nerve (from the naso-palatine) runs close to it in a similar direction, but is small, and by no means easy to dissect. To see it perfectly requires a part which has been specially prepared in dilute nitric acid. However, upon a favourable dissecting-room part, the nerve may be traced, like the artery, from the upper and back part of the membrane to the anterior palatine foramen. The nerve should be carefully searched for where it is thickest and strongest, that is, above and behind. When the septal nerve and artery

have been found, the mucous membrane should be carefully removed, in order to expose the septal cartilage. The attachments of the cartilage to the bones are to be made out, and also, if not already done, the way in which the lower lateral cartilages of the alæ turn in to form part of the septum. The fibres of the olfactory nerve are distributed to rather more than a third of the upper part of the septum, but are so very delicate that they are not likely to be seen. The grooves in which they lie can easily be seen upon the dried bones, and should be examined upon them.

Upon the outer portion of the section the following things are to be made out:

Sinuses: frontal, sphenoidal, and ethmoidal.	Nasal duct.
Spongy bones.	Opening of antrum.
Meatuses (three).	Infundibulum.
Nerve supply.	Openings of ethmoidal and sphenoidal sinuses.
Blood supply.	Meckel's ganglion.

There should be no difficulty in recognising the three turbinated bones, one above the other. It should be observed that the inferior turbinated bone is about on a level with the infraorbital foramen; the middle, with the inner canthus; the superior, just above and behind the middle. A small blood-vessel runs from behind forward along each spongy bone, and may be seen through the mucous membrane, if well injected, coming from the naso-palatine branches of the internal maxillary artery. There is a very abundant plexus of veins lying in the grooves of the inferior spongy bones. To demonstrate them in a proper manner would require a careful injection; being collapsed, the grooves in which they lie are quite apparent, and serve to indicate their number and position. Before removing any of the mucous membrane, probes or bristles

should be passed into all the openings into the meatuses. The meatuses are the spaces beneath the spongy bones, and are therefore three in number, called inferior, middle, and superior. The nasal duct opens into the inferior meatus, and a probe pushed upwards immediately beneath its anterior extremity will be found to enter it. When the appendages of the eye were dissected, the probe was passed from above. To see the opening of the duct, the anterior extremity of the inferior spongy bone should be cut away with bone forceps. Between the middle and inferior spongy bones, one, or perhaps two, small apertures can easily be seen leading into the antrum of Highmore, and beneath the anterior extremity of the middle spongy bone is an opening through which a probe can be passed into the frontal sinuses. It is called the infundibulum, and receives the ethmoidal sinus as well as the frontal. Into the superior meatus the sphenoidal and posterior ethmoidal sinuses open, but their apertures are small, and concealed by mucous membrane. Usually the posterior ethmoidal sinuses open into the sphenoidal, and through them into the superior meatus. It is sometimes easiest to pass a probe from the sinuses, both the frontal and sphenoidal, into the nose. The spheno-palatine foramen also opens into the superior meatus, but cannot be seen until the mucous membrane is cleared away. The nerve supply of the outer wall of the nose may now be examined. The same remarks apply to this as were applied to the septal nerves. Unless the part has been soaked in dilute nitric acid, the nerves will be very difficult to find and trace. They are very slender, and lie deeply in the mucous membrane. They are usually derived from Meckel's ganglion, or from its descending branches. The highest one, that which goes to the superior meatus and spongy bone, usually enters the nose by the

spheno-palatine foramen. The branches to the middle and inferior spongy bones enter the nose through foramena which lead into the posterior palatine canal. To dissect these nerves, and the small arteries which run close to them, the student should probe the mucous membrane of the superior meatus with the point of his knife, in order to find the naso-palatine foramen. Where the bone is deficient, the knife will meet with no resistance. Once found, the foramen should be cleaned of mucous membrane, and divided ends of the naso-palatine nerve and artery, already seen upon the septum, made out. The small nerve and artery which go to the superior meatus may also be seen. The posterior palatine canal descends quite vertically from the spheno-palatine foramen, but is still concealed by the mucous membrane and the vertical plate of the palate bone. The strip of mucous membrane, extending from the lower border of the spheno-palatine foramen to the palate, should be carefully removed, and the nerves searched for coming out of apertures in the bones. They may be traced forwards on to the middle and inferior spongy bones. At quite the front part of the nasal cavity, and upon the inner surface of the nasal bone, the only portion of the nasal nerve which has not been seen may be looked for. Trace the nerve downwards from the nasal slit, where it has already been seen, as far as the anterior nerves, where it emerges between the nasal bone and lateral cartilage. If the nasal slit has been destroyed upon this side of the head, the nerve may be traced upon the opposite side by cutting away the crista galli and as much of the septum as is necessary.

Dissection of Meckel's ganglion.—Meckel's ganglion lies external to the spheno-palatine foramen, and, therefore, external to the palate bone. It lies in

a fossa called the spheno-palatine, or spheno-maxillary, which has the superior maxilla in front and base of the pterygoid process of the sphenoid behind. The ganglion, and its most important branches, require to be exposed. To see the ganglion itself, the student should begin in the nasal cavity, and the bone which surrounds the spheno-palatine foramen should be freely removed with bone forceps. At the same time the orbital process of the palate bone and body of the sphenoid should be cut away. At present the sphenoid is only to be removed sufficiently to expose the foramen rotundum and superior maxillary nerve passing through it. This nerve should be carefully cleaned, and traced forwards towards the spheno-maxillary fissure. One or more branches should be sought for descending into the spheno-maxillary fossa, and disappearing amongst a quantity of fat and connective tissue. If these branches be carefully followed down they will lead to a reddish mass, which is the ganglion. The internal maxillary artery enters the spheno-maxillary fossa through the pterygo-maxillary fissure, and breaks up into very numerous branches. These arteries follow the branches of Meckel's ganglion, and may assist in finding them. They get greatly in the way, but if possible are to be preserved. The largest branches of the ganglion emerge from its internal, posterior, and inferior surfaces. The posterior branch (Vidian) should be found and traced backwards into the Vidian canal. To trace it through the canal it is necessary to remove more of the base of the pterygoid process. As this is being done a small nerve and artery may be seen running backwards through a canal upon the inner surface of the base of the pterygoid process. These are the pterygo-palatine nerve and artery running backwards to supply the mucous membrane at the upper part of the pharynx. Being very small they

are easily overlooked. Continuing to remove the bone, the Vidian canal, and the artery and vein which it contains, are exposed. Behind, the nerve may be said to divide upon the internal carotid artery into two branches; one going to the sympathetic plexus

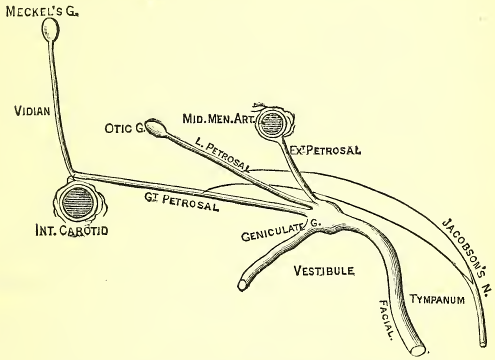


Fig. 43.—Facial and Petrosal Nerves of Right Side.

around the artery, the other is the great petrosal nerve, which has been previously seen coming from the intumescentia ganglioformis. Therefore Meckel's ganglion resembles other ganglia in that it has motor, sensory, and sympathetic roots, which come from the facial, superior maxillary, and sympathetic respectively. All the other branches of the ganglion are called its branches of distribution. The Vidian artery, when injected, can be seen accompanying the nerve, and serve as a guide to it during the dissection of the base of the skull. The descending branches of Meckel's ganglion pass down the posterior palatine canal, and are still concealed from view by the vertical process of the palate bone. This should be removed

with the bone forceps, and the canal exposed down to the palate. The next stage of the dissection is to trace the nerve out of the posterior palatine foramen to their distribution on the palate and roof of mouth. The posterior palatine foramen lies vertically below the posterior palatine canal, and if the mucous membrane of the palate be removed in this situation, the posterior palatine nerve and artery can be found emerging. Their branches are to be traced backwards into the soft palate, and forwards along the hard palate to the anterior palatine foramen, where communications are formed with the anterior palatine vessels and nerves, which have been already traced down the septum of the nose. By this time it will be found that posterior, descending, and internal branches of Meckel's ganglion have been traced. The student should carefully recapitulate them, and see that he can roughly trace the course of each. (Branches have been described entering the orbit.)

The only thing which remains to be done upon the portion of skull which remains is to dissect the anterior and posterior dental branches of the superior maxillary nerve. After the superior maxillary nerve has crossed the spheno-maxillary fossa, it goes into a groove on the orbital surface of the superior maxilla. As it enters this groove it passes through the spheno-maxillary fissure, and gives off two branches ; one (the temporo-malar or orbital branch) has already been seen. The other descends to enter the zygomatic surface of the superior maxilla. It runs forward in a canal, situated just above the fangs of the teeth, until it joins the anterior dental nerve. The anterior dental is given off from the superior maxillary nerve just before it emerges upon the face to become the infraorbital. It runs downwards in the front wall of the antrum to form a loop with the posterior dental nerve. From this loop branches are given off

to the fangs of all the teeth in the upper jaw. To see it the bone should be carefully removed with bone forceps or file. To do this the upper wall of the infraorbital foramen should be taken away, and the anterior dental nerve traced down from the infraorbital. Above the fang of the canine tooth the two nerves meet, and make a sort of plexus (ganglion of Bochdalek). If the bones have been previously soaked in nitric acid, the earthy salts are removed, and their branches can almost be seen without any dissection; if not, the plexus will probably be overlooked.

CHAPTER XIII.

DISSECTION OF THE EYE.

HUMAN eyes are not available for dissection, but the eye of an ox, sheep, or pig will serve to display all that is requisite. It will be presumed that the student has obtained three or four bullocks' eyes in as fresh a condition as possible. Any butcher will provide them at a short notice. The attachments of muscles to the exterior of the globe has already been studied with the dissection of the orbit. However, this is a favourable opportunity to revise them. The conjunctiva, which is the loose mucous membrane covering the front of the eye, should be removed. Beneath it there is some very delicate and loose connective tissue, so arranged as to form a sort of serous sac round the front of the eye. This connective tissue is called the capsule of Tenon, and it facilitates the movements of the globe. If, in a fresh body, the conjunctiva be gently seized with the forceps, it can be lifted up alone; seized more strongly, the capsule of Tenon is grasped. If a snip be made with scissors, a probe can be passed into a sac which is formed by the capsule.

As it covers the tendinous insertions of the recti and obliqui, it must be removed before they can be seen. The posterior part of the globe and its muscles is usually concealed by a quantity of orbital fat, which the butcher removes with the globe. This should be removed, to display remainder of the muscles. In the bullock's eye there is an unusual quantity of muscle, owing to the presence of an additional one, called the retractor bulbi. This is a circular tube of muscular fibres, which surrounds the optic nerve, and is attached to the sclerotic in front, and round the optic foramen behind. All the muscles must be cleaned carefully away from the sclerotic. About a quarter of an inch of the large nerve (optic), which enters the globe behind, should be preserved. The exact place at which the optic nerve enters the eye should be noticed. Instead of entering the centre of the globe behind, it enters quite to the inner side of this point.

The student should now provide himself with a small basin of water. In winter it will add to the dissector's comfort if the water is warmed a little. Whenever, during the dissection, the water becomes turbid, it should be renewed. A pair of sharp-pointed, curved scissors will be found most useful. Not less than two or three eyes should be prepared ready for further dissection. The first is to be divided vertically from before, backwards, so as to display its antero-posterior section (Fig. 44). The section can be performed moderately well with scissors when the eye is immersed in the water. To get a perfect specimen, a basin of pounded ice, mixed with salt (equal parts of ice and salt), should be obtained. The eye should be kept covered with the mixture until quite hard, when a section may be made through it with a razor. The eye should be placed upon a piece of cork or soft wood, and a rapid section made. When this has

been successfully accomplished, the two halves may be floated in the basin of lukewarm water and examined. In the axis of the eye the following

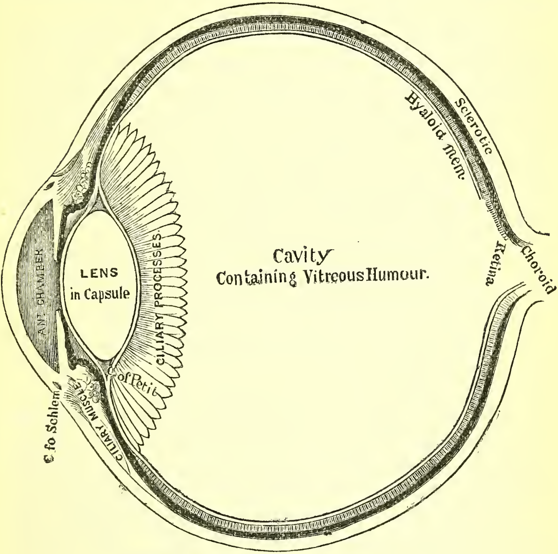


Fig. 44.—Vertical Section of an Eye.

structures will be met with. (The axis of the eye is a line drawn through the centre of the cornea, pupil, lens, and back of the sclerotic).

Cornea.
Anterior or aqueous chamber.
Iris (pupil).
Crystalline lens.
Posterior chamber, containing vitreous humour.
Yellow spot and retina.
Choroid and ciliary processes.
Sclerotic.

Ophthalmic surgeons always call the vitreous

chamber the posterior chamber of the eye. This is the sense in which it is used here. Most books on anatomy apply the expression posterior chamber to the space between the posterior surface of the iris and the front of the lens.

The entrance of the optic nerve is towards the inner side of the axis. In the bullock's eye the entrance of the optic nerve in the interior is indicated by the diverging fibres, and by the passage through its centre of the central artery and vein of the retina, but in human eyes it presents the appearance of a white circular disc, slightly elevated, called the optic disc. Upon the antero-posterior section, the following points also require to be studied:

(1) The way in which the sclerotic overlaps the edge of the cornea.
(2) The attachments of the iris.
(3) Boundaries of the anterior chamber.
(4) Boundaries of the posterior chamber.
(5) Ciliary bodies.
(6) Position of the crystalline lens.

The back part of the bullock's eye looks very like the interior of a mussel-shell, owing to the presence of glistening white pigment in the choroid. This mother-of-pearl-looking membrane is called the tapetum.

For a full description of all these points the student should refer to his text-books. The handle of the knife should be passed under the inner edge of the iris, to show the posterior part of the anterior chamber. The withdrawal of the handle of the knife will probably bring away a quantity of pigment (uvea) from the back of the iris, which is abundantly covered with it. In the posterior chamber the different parts can be studied, either upon the vertical section, or upon a horizontal one made through the middle of the globe. The student should take another of the eyes which he has cleaned, and,

keeping it immersed in water, should push the point of a sharp knife into it about the middle of the sclerotic. Into the aperture made with the knife, a very fine, sharp pair of scissors may be introduced, and all the tunics of the eye cut through, and the posterior chamber opened. The vitreous should next be divided, so as to have some on the back and some on the front of the globe. On the posterior portion the dissector should see the

Retina.	Choroid.
Retinal vessels.	Lamina fusca.
Optic disc.	Entrance of ciliary vessels and nerves.
Yellow spot.	
Tapetum (in bullock's eye).	

The retina in the living eye would be perfectly transparent, but in the eye which is being dissected will look like a layer of wet tissue paper spread over the back of the posterior chamber. The retinal vein is usually naturally injected, and is easily seen passing into the eye through the centre of the optic nerve, and spreading over the retina. By a natural injection is merely meant that the vein remains full of blood. The central artery of the retina (arteria centralis retinæ) enters at the same place as the vein, but being uninjected easily escapes notice. Its branches may be seen as very delicate threads running over the retina independently of the veins. External to the optic nerve the retina in the human eye presents a very small area, where it sometimes appears more opaque than elsewhere.* This is the yellow spot, and the student must not be surprised if he cannot see it, as it is often indistinguishable. The veins and arteries of the retina as they pass from the optic nerve divide into two great trunks, which run above and below the yellow spots to the outer side of the globe. The

* There is no yellow spot in bullocks' eyes.

handle of the knife may be gently introduced beneath the retina to detach it from the deeply pigmented choroid beneath it. The pigmentary layer of the choroid really belongs to the retina, as developmental considerations show. (*See* Klein's "Elements of Histology," p. 315.) The retina is attached only at the yellow spot, and around the entrance to the optic nerve, but this attachment cannot be seen in the dissecting-room. If the handle of the knife be now introduced between the choroid and sclerotic a number of small white nerves may be seen piercing the sclerotic, and running forwards upon its inner surface. They lie in a certain amount of greyish pigment (lamina fusca), which remains upon the sclerotic when the choroid has been detached. These are the ciliary nerves, which were traced as far as the sclerotic when the orbit was dissected. The two long ciliary, which are of larger size than the others, run along the right and left sides of the sclerotic to reach the cornea.

The dissection of the front of the globe may now be begun. It includes the

Retina and ora serrata.	Iris.
Vitreous humour and zone of Zinn.	Ciliary nerves (terminations).
Crystalline lens.	Ciliary ligament.
Canal of Petit.	Cornea.

The retina can easily be seen in the human eye extending as far forwards as the ciliary processes, where its edge is slightly irregular, and is called the ora serrata. This serrated edge does not exist in bullocks' eyes. The ciliary processes are folds or pleats of the choroid, and are situated all round the edge of the crystalline lens. They radiate from before backwards, and are about fifty in number (fifty to eighty). Both the ciliary processes and the ora serrata can be seen without

removing the anterior part of the vitreous. A fine blow-pipe must now be obtained. A piece of glass tubing may be warmed in the flame of a spirit lamp until almost melting. It may then be pulled out, and the most slender part broken through. If the point of this blow-pipe be pushed through the vitreous humour as far as the margin of the lens, and a little air blown through it, a circle of small air-bubbles appears all around the margin of the lens. This is the canal of Petit, and is probably the small chink left between the edge of the lens and the inside of its capsule, the circumference of the capsule being slightly greater than that of the lens. The constrictions are caused probably by certain fibres of the lens capsule being shorter than others. The handle of the knife may now be pushed between the retina and vitreous, over the ciliary processes, and under the margin of the lens. The object of this is to turn the anterior part of the vitreous, with the lens imbedded in it, out of the anterior part of the globe. If this portion of vitreous and lens be floated in the water, the imprints of the ciliary processes can be seen upon the surface of the vitreous around the margin of the lens. A certain amount of pigment comes off the edges of the processes and forms this pigment zone, usually called the zone of Zinn. Although spoken of as being upon the surface of the vitreous humour, this pigment is really upon a capsule which contains it, called the hyaloid membrane. This membrane is invisible to the naked eye, but in front, where it is strongest, it splits to inclose the crystalline lens, and form its capsule, or, as it is sometimes called, the suspensory ligament.

The handle of the knife may now be used to detach the choroid, ciliary processes, and iris from the front of the sclerotic. In doing this the ciliary nerves can be seen, the smallest and most numerous ones

entering the iris, and the two largest passing on to the cornea, at the margin of which they are lost. With the naked eye nothing more can be seen of the structure of the choroid, ciliary processes, or iris. At the place where the cornea and sclerotic meet, there is a whitish line, about one-fifth of an inch wide. This is the so-called ciliary ligament. It is, as a matter of fact, composed of unstriped muscular fibres, and is now called the ciliary muscle. Some more of it can be seen upon the detached portion of iris and choroid at the point where they meet. The mass of tissue formed by the ciliary muscle and ciliary processes was formerly called the ciliary body, owing to an imperfect conception of its use and structure. This region should be studied upon proper microscopic sections.

The last thing which remains to be done is to displace the crystalline lens by tearing through its capsule in front, and squeezing it between the fingers. Two facts concerning it will be demonstrated: that it is elastic; and that it consists of an outer soft and an inner hard part, called the nucleus.

The arterial and nervous supply of the iris are subjects of great practical importance, and the student should endeavour, with the aid of his text-books and properly-prepared anatomical and microscopical specimens, to make himself quite familiar with them. He should also ascertain what the ciliary zone of blood-vessels is, and how it is formed.

CHAPTER XIV.

DISSECTION OF THE BRAIN.

The brain should be removed from the fluid in which it has been kept, and placed upon a clean board,

with its base upwards. A moist cloth should be wrapped round the hemispheres to afford them support. The student will be greatly assisted in understanding the brain if, before he begins to dissect it, he acquires a rough idea as to where its most important parts are situated, and their relative positions. If possible, he should endeavour upon a museum specimen to make out, with the aid of his text-book, the position of the great ganglia and ventricles. Specimens which have been in spirit or nitric acid do not show clearly the grey and white matter. It is not possible always to tell where one begins and where the other ends, but, in any case, there should not be much difficulty in making out the larger masses of grey matter. As far as concerns the functions of animal life, movement, and sensation, the parts along the base of the brain are the most important. The medulla oblongata is simply the continuation of the spinal cord; and the two crura cerebri are the continuations of the medulla oblongata. The pons Varolii merely joins the two halves of the cerebellum together, and, in doing so, crosses beneath the continuation upwards of the medulla into the crus.

The crura cerebri appear to enter the temporo-sphenoidal lobes, but if all the convolutions of the brain were taken away, they would be seen to end in the ganglia at the base of the brain. These ganglia are placed one in front of the other, upon the upper surface of the crus: that in front is called the corpus striatum; the one behind, the optic thalamus. Behind the optic thalami, but smaller and of less importance, are the corpora quadrigemina. If the tempero-sphenoidal lobe were lifted up, and a knife pushed into the crus cerebri beneath, it would enter the optic thalamus. If the fissure of Sylvius be opened, and a knife pushed through the anterior perforated spot, it will enter the corpus striatum. (*Vide* page 353). If

the brain could be bisected exactly in the middle line, it would be found to consist of two symmetrical halves. Each half would consist of half the medulla oblongata, half the pons Varolii, crus cerebri, optic thalamus, corpus striatum, corpora quadrigemina, cerebral hemispheres, and cerebellum. The two sides of the creebellum have already been seen to be joined together by a transverse band of nerve fibres, called the pons Varolii, or commissures of the cerebellum.

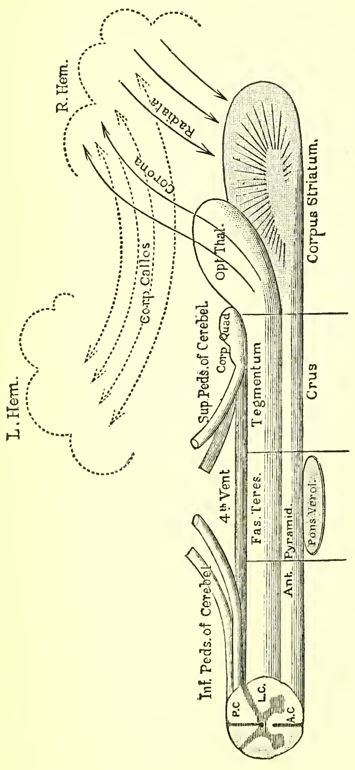


Fig. 45.—Course of Fibres from the Spinal Cord into the Brain.

When the hemispheres are dissected, they will be seen to be joined by an exactly similar commissure, called the corpus callosum.

The optic thalami and corpora striata will also be seen to be joined together by commissures, called the anterior, middle, and posterior.

It can easily be seen that there is no separation *below* between the two sides of the medulla; but in front of the pons Varolii the crura cerebri can be seen diverging, so that where they are lost beneath the temporo-sphenoidal lobes they are nearly half an inch apart. The great ganglia which lie upon the crura diverge in a similar manner, so that there is an interval between the optic thalami, and a wider interval between the corpora striata. The space between the optic thalami is called the third ventricle, and if the position of the thalami be noted, it will be found to correspond to the interval between the diverging crura cerebri. The interval between the corpora striata is more in front, and would lie between the two anterior perforated spots. At a later stage it will be seen how it is occupied. Besides the space between the ganglia, there is also an interval (lateral ventricles) between their upper surface and the cerebral hemispheres. When all these cavities are exposed, it will be seen that there is no real line of separation between them, that they are practically one space.

Of course, if the brain is intact it is not possible to look into the space between the crura cerebri (interpeduncular space), and see into the third ventricle. A thin layer of grey matter is spread from one crus to the other, and forms the floor of the ventricle. This layer of grey matter is not quite a flat layer. In front, the optic chiasma lies beneath it, and behind the chiasma it is prolonged in a funnel-shaped process (tuber cinereum), to attach the pituitary body to the brain.

If a delicate incision be made into the infundibulum, it will be found to be hollow.

The different portions of the brain may be studied in the following order:

(1) Base of brain.
(2) Hemispheres.
(3) Interior of the brain, and its ventricles.
(4) Cerebellum.
(5) Medulla oblongata and fourth ventricle.

The anterior portion of the cerebral hemispheres is called the frontal lobe. Separating the frontal lobes is the anterior part of the great longitudinal fissure which divides the hemispheres. This fissure should be opened, in order to see within it the corpus callosum, which has already been stated, and will afterwards be seen to be the great commissure, or bridge of fibres, which joins the cerebral hemispheres together. In front it does not extend as far as the anterior extremity of the cerebrum, but presents a rounded edge, called its genu. Behind it is seen continuous, beneath the optic chiasma, with the layer of grey matter already mentioned as joining the crura cerebri together. The small area of grey matter in front of the optic chiasma is called the lamina cinerea. Upon the under surface of the frontal lobes a number of convolutions may be seen, and the olfactory bulbs. The latter are joined to the brain by three roots. As the arachnoid and pia mater have been taken away, no further dissection is required to show the inner root running towards the lamina cinerea, and the outer into the Sylvian fissure. To see the middle root, the bulb must be lifted from the brain with forceps, and the root looked for entering the posterior and under extremity of the olfactory bulb.

Between the temporo-sphenoidal and frontal lobes is one of the deepest and best-marked fissures (Sylvian) of the brain. If the Sylvian fissure be opened and traced outwards, it will be seen to bifurcate. About five convolutions of average size lie in

the bifurcation. These constitute the island of Reil; or, owing to the fact that unless the fissure is opened they are concealed from view, it is sometimes called the operculum, and the convolutions gyri operti (concealed gyri). The things to be looked for in the Sylvian fissure are:

Island of Reil.	Middle cerebral arteries.
Outer root of olfactory bulb.	Processus cuneatus.
Anterior perforated spot.	

All of these structures have been seen, except the last, which is simply a hill formed by a bundle of antero-posterior fibres, joining the temporo-sphenoidal to the frontal lobe. It is mentioned here in order that attention may be drawn to the fact that not only are the two sides of the brain united by fibres, but also that the lobes and gyri are connected with each other. After the optic tracts have been followed a little way round the crura cerebri, the space (interpeduncular), which is bounded by the chiasma in front and the crura or peduncles of the cerebrum behind, may be examined. The structures found in the interpeduncular space are the

Third pair of nerves.	Tuber cinereum and infundibulum.
Corpora albicantia.	Posterior perforated spot.

The superficial origins of the cranial nerves have been seen before (page 227). The two whitish lumps (corpora albicantia) are formed by a twist, which occurs in a bundle of nerve fibres called the fornix. The position of the corpora albicantia should be remembered, and later on the fornix traced to them. The tuber cinereum is easily recognised, especially if the pituitary body has been preserved, for it attaches the latter to the brain. The tube is pyramid-shaped. Its base is applied to the brain; its apex to the pituitary body.

The apex near the pituitary body is slighly elongated, and is called the infundibulum. The small apertures near the convergence of the crura cerebri are called the posterior perforated spot. The arteries which pass through them come from the posterior cerebral, and go to the third ventricle, crura, and optic thalami. If great care was taken in removing the posterior cerebral and superior cerebellar arteries from the crura, the slender fourth nerves may be seen winding round the crus in a similar manner to the optic tracts.

The pons Varolii requires hardly any more dissection. The fifth nerve should be observed piercing in, and the small white motor root of the nerve searched for. The groove along the centre of the pons is for the basilar artery.

The under surface of the medulla oblongata, and the nerves which arise from it, are next to be dissected. This surface has upon it the

Anterior pyramids.
Lateral tracts.
Decussations of pyramids.
Foramen cæcum.
Median fissure.
Olivary bodies.
Arciform fibres (of Rolando or Solly).
Sixth nerves.
Eighth nerves.
Ninth nerves.

The two halves of the medulla are separated by a deep median fissure. Near the pons this fissure ends in a small pit (foramen cæcum). Below, it is interrupted, about an inch below the pons, by a bundle of fibres, which cross from one side of the medulla to the other. The rounded cords at each side of the median fissure are called the anterior pyramids. They are merely the continuations upwards of the anterior columns of the cord, somewhat thickened. Just below the pons Varolii, and external to the anterior pyramids, are two small lumps (olivary bodies), one on each side; the delicate fibres which wind round their lower ends are the arciform fibres of Rolando. If a

cut be made into the olivary bodies, they will be seen to contain a capsule of grey matter (nucleus dentatus). The olivary bodies conceal from view the greater part of the continuation upwards of the lateral columns of the cord. These columns, like the anterior, become a little larger in the medulla, and are called the lateral pyramids, or lateral tracts. The nerves which arise from the medulla may now be examined. The sixth arise between the anterior pyramids and the pons. The ninth, or hypoglossal nerves, arise just in front of the olivary bodies; the eighth pair, exactly behind them. After their origin, the eighth nerves lie upon a very flocculent-looking portion of the cerebellum, called the flocculus or pneumo-gastric lobe. The eighth nerves may possibly be confused with the seventh pair, which arise close to, but just in front of, them.

Hemispheres of the brain.—The most important of the fissures and convolutions which cover the surface of the brain should be studied first, afterwards the corpus callosum, and lastly its interior.

If great care be taken, the fissures and convolutions can be all made out upon a brain which has not been divided in any way. But if possible a cerebral hemisphere should be used which has been separated from the brain in the following manner: Place the brain upon the table with its base downwards. Open the great longitudinal fissure, and divide the corpus callosum close to the hemisphere which is about to be removed. Afterwards, divide the posterior pillar of the fornix and velum interpositum. Continuing to draw the hemisphere away from the rest of the brain, divide on the same side the corpora quadrigemina, crus cerebri, and the anterior, middle, and posterior commissures which lie internal to the optic thalamus and corpus striatum, and which are by this time in view. To separate the hemisphere, the remainder of

the corpus callosum, its genu and rostrum, and the following structures at the base of the brain, require to be divided : lamina cinerea, optic tract, and tuber cinereum.

To manipulate the brain in this way requires rather more skill and knowledge than the student has yet acquired. Without making any sections upon the brain before him, he should proceed to learn the most important convolutions and fissures. The external surface of each hemisphere is divided into three regions, frontal, parietal, and occipital. The frontal region is divided from the parietal by the fissure of Rolando, which lies between two convolutions, which extend vertically from the great longitudinal fissure above almost to the fissure of Sylvius below. As these are the only convolutions which run in this direction down the side of the hemisphere, there should be no difficulty in finding the fissure of Rolando. The region behind the fissure of Rolando is the parietal. It is separated from the occipital region by a short sulcus, called the external parieto-occipital. To find this fissure, it is best to look at the internal surface of the hemisphere, and find it on the inner side, where it is called internal. Beginning at the inner surface of the occipital part of the brain, there is a wedge-shaped lobe (cuneate), and in front of it a square lobe (quadrate) ; the fissure between the wedge and the square is the internal parieto-occipital. It usually passes over the edge of the hemisphere a little way, where it is called the external parieto-occipital. The anterior inferior angle of the quadrate lobe becomes continuous with a convolution which runs just above the corpus callosum, and which may be traced all round it, both behind and in front. This is called the convolution of the corpus callosum, or gyrus fornicatus. The fissure between it and the corpus callosum is called the callosal fissure, or ventricle of the corpus callosum. The

convolution above the gyrus fornicatus, and near the margin of the hemisphere, is called the marginal, and the fissure between the marginal and callosal convolutions is named the calloso-marginal fissure.* If the student now turns his attention to the wedge-shaped lobe, the fissures which bound the wedge will of course be found to converge in front until they form one fissure. This single fissure is continued on for a little distance, and is called the calcarine. A little below the calcarine fissure is another, of considerable size, running parallel to it, called the collateral. These fissures are important, because later on they can be seen to dip so far into the interior of the brain that they make hills in the interior of the ventricles, called the calcar, or hippocampus minor, in the case of the calcarine fissure, and collateral eminence in the case of the collateral fissure. The collateral fissure is not always easy to find, but the rule that it is the next large fissure below the calcarine generally holds good. If the gyrus fornicatus be traced round the posterior margin of the corpus callosum, towards the end of temporo-sphenoidal lobe, it will be found to end in a little hook, which is called the crochet. The convolution which runs directly backwards from the crochet, and which lies about the collateral fissure, is sometimes called the uncinate. Lastly, the convolutions upon the under surface of the temporo-sphenoidal lobes remain to be examined. And it will be seen that there is no well-marked line of separation between the under surface of this lobe and the occipital. The student should refer to his text-books of descriptive anatomy for fuller information concerning the convolutions.

The brain still lying with its base upon the table, the great longitudinal fissure should be gently separated

* The remaining fissures and convolutions cannot be seen unless a separate cerebral hemisphere is obtained.

with the tips of the fingers, in order to expose the upper surface of the corpus callosum. The anterior cerebral arteries have been previously seen and removed, and it is not difficult to see that the corpus callosum is composed of transverse fibres (striæ transversæ). It has been seen before that it does not extend either as far forwards or as far backwards as the hemispheres. The posterior extremity (pad, splenium, bourrelet) should be raised, by keeping the cerebellum depressed and lifting up the hemispheres; it will be seen that it is thick and round, and that the pia mater passes into the interior of the brain beneath it. The aperture through which the pia mater enters is called the fissure of Bichat. Later on, when a vertical section has been made of the corpus callosum, the pad behind and genu in front will be seen to be the thickest parts, owing to the fact that a greater number of transverse fibres pass through these portions of the corpus callosum to join the frontal and occipital lobes of one side to those of the other. Running along the middle of the corpus callosum, and turning over the genu in front, are two small longitudinal bands of fibres (nerves of Lancisi). If the gyrus fornicatus be lifted up, so as to expose the ventricle of the corpus callosum, similar bands can sometimes be seen in it (covered bands of Reil, striæ obtectæ). If it is desired to see the transverse fibres of the corpus callosum radiating outwards (Fig. 45) to join the convolutions of opposite sides together, a very well-hardened brain should be chosen, and the hemispheres torn away at the level of corpus callosum. The radiating fibres cannot be traced in their continuity, but simply give the torn brain a fibrous appearance (fibrous cone of Mayo; corona radiata). If the student attempts to see this upon the brain he is dissecting, great caution is required lest important parts in the interior be lacerated.

Dissection of ventricles.—Presuming that no tearing has been done, and that the brain is still intact, its interior may now be examined. It has been mentioned that an interval exists between the great ganglia of opposite sides; it has now to be seen that the hemispheres are hollow in their interior. These hollows are called ventricles, and communicate with each other. Of course, the ventricle between the optic thalami, third ventricle, is in the middle line. The ventricles in the hemispheres are at each side of it, and are called lateral. The lateral ventricles are situated beneath the fibres of the corpus callosum, as they spread out into the hemispheres and above the great ganglia. Roughly speaking, therefore, the floor of the lateral ventricles is formed by the optic thalamus and corpus striatum; the roof by the corpus callosum. When the lateral ventricle is opened, it will be seen to send a prolongation, or horn, into each of the great lobes, frontal, temporo-sphenoidal, and occipital.

To expose the lateral ventricle, the cerebral hemispheres are to be sliced away in the following manner: A very thin and flat knife, with a blade about twelve inches long, should be obtained (this is not absolutely necessary), and its blade dipped in dilute spirits before it is used. The hemisphere should be supported with the left hand, and sliced off at the level of the corpus callosum. This section shows that the surface of the convolutions is covered with grey matter, and that their interior is composed of white (centrum ovale majus). If the brain were fresh, the small veins would be seen as red points on the surface of the section (puncta vasculosa). A little way from the corpus callosum the handle of the scalpel should be used to plough up the white matter, or very thin slices may be removed with the knife; a villous and vascular-looking structure will

come into view. This is the choroid plexus, and it forms the chief contents of the lateral ventricle. No difficulty should now be experienced in pushing the handle of the knife very gently into the ventricle in different directions. The white matter forming the centrum ovale should be lifted up, and removed in such a manner as to lay bare the anterior and posterior horns of the ventricle, but still leave a strip of corpus callosum, about three-quarters of an inch wide, in the middle line. Especial care must be taken near the splenium not to injure the posterior pillars of the fornix. The sharp, tape-like edges of this structure are seen diverging at each side from beneath the posterior end of the corpus callosum. The structures seen in the lateral ventricles are:

Velum interpositum and choroid plexus.
Posterior pillars of the fornix.
Optic thalamus.
Corpus striatum.
Tænia semicircularis.
Anterior, middle, and posterior horns.
Calcar, or hippocampus minor, in posterior horn.
Eminentia collateralis, between middle and posterior horns.

In middle horn.
Choroid plexus.
Tænia hippocampi (also called corpus fimbriatum, or processus fimbriatus, or posterior pillar of the fornix).
Hippocampus major.
Pes hippocampi.
Eminentia collateralis (sometimes).

All the structures within the bracket are in the descending horn of the lateral ventricle.

The choroid plexuses of the lateral ventricles are situated upon the outer edge of a layer of pia mater (velum interpositum). The student will remember that he lifted up the splenium in order to see the pia mater enter the interior of the brain beneath it. As soon as the pia mater has got beneath the corpus callosum it spreads out like a fan. The front and outer margin of this fan is thickened and villous, and forms the

choroid plexuses. At present the choroid plexus can be seen externally disappearing from view into the descending, or middle, horn of the ventricle. Internally its pia mater (velum interpositum) is lost to view beneath the posterior pillars of the fornix and corpus callosum. The finger (or handle of knife) may now be introduced into the anterior horn of the ventricle, and its length and direction ascertained, and its roof taken away. Next, the posterior horn should be opened in a similar way. There is a spur-shaped elevation upon its inner wall, called the hippocampus minor, or calcar. The handle of the knife should be introduced into the calcarine fissure, to see that the eminence is caused by the closeness of the bottom of the fissure to the interior of the ventricle. If the knife be pushed well in, the calcar becomes more prominent. Before touching the choroid plexus, the descending horn of the lateral ventricle should be examined. The direction of the posterior pillar of the fornix, or of the choroid plexus, will serve as a guide. Although they lie beneath the choroid plexus and velum interpositum, two lumps, about as big as a pigeon's egg, may be easily seen protruding into the lateral ventricle. The most anterior one (corpus striatum), which is dark-grey in colour, has been already mentioned. The point already noticed may be confirmed, that a needle passed through the anterior perforated spots pierces it. Another pin may be passed through the posterior elevation (optic thalamus) in order to see that it pierces the crus. The middle, or descending horn, of the lateral ventricle descends, at first backwards and outwards, then forwards and inwards, around the posterior edge of the optic thalamus, until, at its termination, it is quite beneath it. The brain substance should therefore be cut away from the side of the hemisphere external to the optic thalamus, in such a manner as to expose the descending horn. The

incisions should be vertical, and from before backwards. The posterior pillar of the fornix can now be followed down as far as the termination of the descending horn. When the posterior pillar has arrived in the descending horn it becomes part of the hippocampus major. If the choroid plexus be lifted up, small blood-vessels can be seen entering it, and notching the edge of the posterior pillar causes it to appear fimbriated. The same vessels indent the grey matter beneath the edge of the hippocampus major (fascia dentata). It may be observed that at this point the grey matter of the cortex of the brain becomes continuous with the grey matter of the interior, *i.e.*, of the hippocampus major. The hippocampus major, and its notched foot-like end (pes hippocampi), can easily be seen when the choroid plexus is removed. The knife handle may now be carefully introduced into the collateral fissure, to see that it corresponds to the eminence upon the floor of the lateral ventricle (eminentia collateralis). Situated at the point where the hippocampus major and minor diverge, this collateral eminence sometimes runs down the middle horn of the lateral ventricle, behind, and parallel to, the hippocampus major. It may be remarked that unless the brain has been hardened gradually and carefully, it is liable to become distorted in shape, so that many of these projections are less prominent than they should be. The great ganglia, and tænia semicircularis, are most conveniently dissected a little later. The next stage of the dissection is to see in their turn the

Fornix and lyra.
Velum interpositum, and veins of Galen.
Great transverse fissure.
Pineal body.
Third ventricle.
Corpora quadrigemina, etc.

The portion of brain, consisting of the radiating

white fibres from corpus callosum, which joins the occipital lobes together (posterior peduncle of corpus callosum), should be divided upon each side. The corpus callosum should then be turned forwards from off the posterior pillars of the fornix, to which it is adherent, as far as the junction of its middle and anterior thirds. Beneath the middle of the corpus callosum the posterior pillars of the fornix, which ascend in an upward curve from the descending horn of the ventricle, unite to form a single bundle called the body of the fornix. Soon it will be seen that the body divides again to form the anterior pillars. Where the posterior pillars of the fornix converge behind, they form rather an acute angle. This angle, situated just beneath the splenium, is bridged over by a few transverse fibres, and is called the lyra. (By some authors the transverse fibres are said to belong to the fornix, others say they are fibres detached from the corpus callosum.)

The posterior pillars of the fornix should be divided, and the body and lyra lifted up, to display the velum interpositum which is beneath it. The veins of Galen should be noted, running along the centre of the velum. They may be seen to collect the blood from the choroid plexuses, and when the plexuses themselves are lifted up, other veins will be seen entering them from the corpora striata. The veins of Galen open into the straight sinus. In the middle line the velum interpositum should be lifted up, to expose the corpora quadrigemina lying beneath it. The corpora quadrigemina are four small masses of grey matter, lying just below the splenium, and upon the crura cerebri. The fissure between the splenium and corpora quadrigemina is the fissure of Bichat. Evidently, the velum interpositum enters the brain through it. The fissure of Bichat, however, is only the central part of a much larger fissure, which is

continued round each crus cerebri as far as the end of the descending horn of the lateral ventricle. In order to see this, the posterior pillar of the fornix should be raised with the handle of the knife, and the posterior portion of the brain, including the temporo-sphenoidal lobe and hippocampus major, gradually pulled away laterally from the optic thalamus which remains upon the anterior portion. It will then be seen that the only part of the brain which is lacerated when this is done is a small portion close to the end of the descending horn, and just internal to the crochet. Small choroidal arteries can easily be seen entering the ventricle through the transverse fissure, and it will be remembered that as they entered they notched the corpus fimbriatum and the grey matter.

Before removing the velum interpositum, it should be followed forwards as far as the anterior pillars of the fornix, at which point the choroidal plexuses of opposite sides will be seen to communicate. The notch between the optic thalamus and corpus striatum is bridged over by the fornix, so as to form a sort of foramen, through which the choroid plexuses pass (foramen of Monro). The velum interpositum may now be raised from behind and removed, together with the choroid plexuses. In doing this, care must be taken not to pull the pineal body away with it. This small body is firmly fastened to its under surface, but should be left attached to the brain, just above the corpora quadrigemina. When the velum interpositum is taken away, the following structures are to be examined :

Third ventricle.
Anterior pillars of fornix and septum lucidum.
Fifth ventricle.
Anterior, middle, and posterior commissures.
Pineal body.
Aqueduct of Sylvius.
Superior peduncles of cerebellum.
Valve of Vieussens.
Fourth nerves.
Optic nerves and corpora geniculata.

The student should begin by making out the boundaries of the third ventricle, and the openings into it. Unless the brain has been manipulated with considerable care, the middle soft commissure which crosses it will have been broken. If this has occurred, it is still possible to see the remains of it upon the middle part of the optic thalami, which it joins. The posterior commissure, which also joins the optic thalami and corpora quadrigemina, is small and white, and is often concealed from it by the pineal gland, which may be drawn backwards to expose it. The peduncles of the pineal gland are the two delicate strands which can be seen to emerge from it, and run along the optic thalami at the upper margin of the third ventricle. The anterior white commissure joins the corpora striata together. It is situated just in front of the anterior pillars of the fornix, so that at present it can only be partially seen at each side of them. The anterior pillars of the fornix will be seen descending towards the base of the brain. When the optic thalami and corpora striata have been completed, they will be removed from one side in order to see the anterior pillars descending to the corpora albicantia. Both the anterior pillars of the fornix and the corpus callosum descend towards the base of the brain, but the curve of the corpus callosum is some distance anterior to the curve of the anterior pillars of the fornix. At the base of the brain they meet again. The interval between the fornix and corpus callosum is occupied by two very thin layers of brain substance (septum lucidum). One side of the septum lucidum should be gently scraped with the handle of the knife, in order to expose an interval, the fifth ventricle, which is between them. A probe should next be passed under the posterior commissure into a canal, which leads from the third ventricle beneath the corpora quadrigemina to another ventricle (the fourth) which

is concealed from view by the cerebellum. Two flat bands are seen passing from the corpora quadrigemina (testes) to the cerebellum; they are the superior peduncles of the cerebellum, or processus a cerebello ad testes. Stretched in the interval between them is a thin layer of brain substance (valve of Vieussens, or superior or anterior medullary velum), from which the fourth nerve arises. This delicate nerve should be traced round the crus cerebri to its front, where it has been already seen. If the optic nerves be also followed backwards round the crus, they can usually be seen to divide. The divisions go to the corpora quadrigemina, but before reaching them they have small elevations upon them, called the corpora geniculata.

The **fourth ventricle** may next be dissected. This cavity is smaller in size than the others, and is situated between the back of the medulla oblongata and under surface of the cerebellum. Before cutting through the cerebellum from above to display this ventricle, its posterior margin should be raised and the medulla depressed, in order to see that the fourth ventricle can be entered in this manner. (This opening is sometimes called the foramen of Majendie.) It seems probable that the arachnoid and a layer of grey matter are torn through in doing this, and therefore the foramen of Majendie is artificial. The names of the different parts of the cerebellum which form the roof of the ventricle may be learnt from a textbook by the more advanced student. Most of them can be seen at this stage. Concerning the fourth ventricle there should be seen

(1) Its boundaries.
(2) Openings into it.
(3) Things seen upon its floor.

Its roof having been examined, the cerebellum should be accurately divided in the middle line until

the fourth ventricle is exposed. This will probably spoil the valve of Vieussens forming the anterior part of its roof. A probe may be again introduced from the third ventricle through the aqueduct of Sylvius. The superior and inferior peduncles of the cerebellum form the superior and inferior boundaries of the ventricle (Fig. 45). The cerebellum is united to the cerebrum above by bands of white fibres, which go to the testes, and are its superior peduncles, or crura, or processus a cerebello ad testes; below, it is united to the medulla and spinal cord by fibres which are continuous with the posterior columns of the cord, and which are called its inferior peduncles, or crura, or restiform tracts. The pons Varolii joins the two lobes of the cerebellum together, and is called its middle peduncle or commissure. These peduncles converge when they join the spinal cord and cerebrum, but diverge where they enter the cerebellum. As they enter the cerebellum they may be seen to cross, the inferior peduncle to go to the highest (most anterior) part of the cerebellum, the superior to go to the lowest part. The lozenge-shaped space which they inclose is the fourth ventricle. Upon its floor the following parts should be made out:

Fasciculi teretes.	Tænia violacea.
Striæ transversæ.	Origins of nerves (grey matter).
Locus cœruleus.	

A median fissure runs along the floor of the fourth ventricle, and ends above in the Sylvian aqueduct, below in an aperture (ventricle of Aurantius) which leads into the central canal of the spinal cord. Emerging from the middle line are a few transverse fibres, which should be traced round the inferior peduncles to end in the auditory nerve; they are called striæ acusticæ, or striæ medullares or transversæ. A longitudinal elevation runs from before

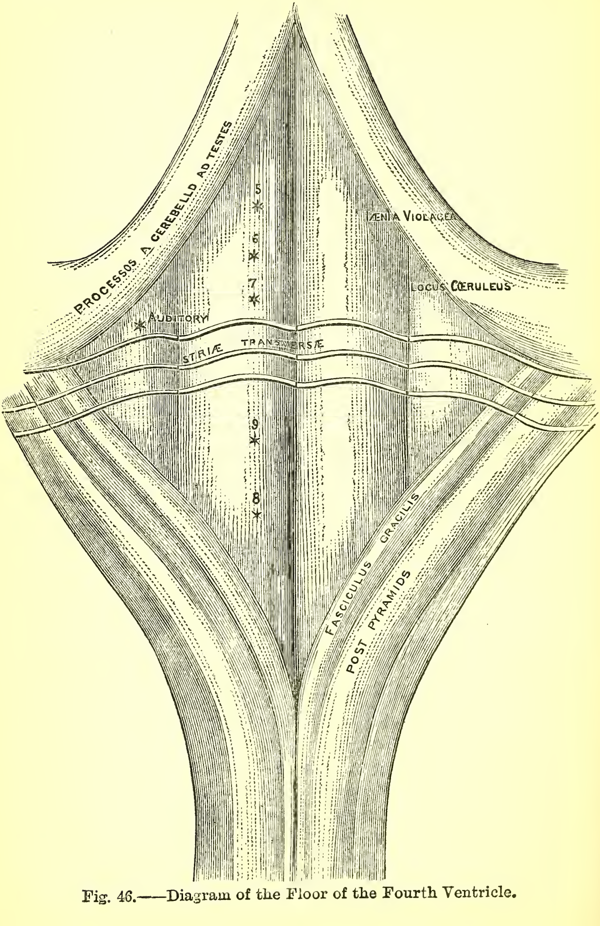


Fig. 46.—Diagram of the Floor of the Fourth Ventricle.

backwards, along each side of the middle line. It is caused by the fibres of the lateral columns of the cord, which are continued up through the floor of the fourth ventricle, as the fasciculi teretes, into the crus cerebri, and thence into the optic thalamus. It has been seen how the posterior columns of the cord diverge to go to the cerebellum. The lateral columns and the grey matter of the cord lie beneath them (looking from behind), so that when the posterior columns diverge, the parts beneath them come into view. In this way the lateral column, under the name of the fasciculus teres, and the grey matter, are exposed upon the floor of the fourth ventricle. (*Vide* Fig. 45, page 342.) The spinal nerves rise from the grey matter of the cord. The cranial nerves, as far forward as the fourth, arise from the grey matter of the medulla. The striæ transversæ divide the floor of the ventricle into an upper and lower part. In the upper part (upon a fresh brain), a bluish-looking spot, locus cœruleus, can be seen. A streak which runs upwards from it is called the tænia violacea. The fifth, sixth, and seventh nerves arise above the striæ, the eighth and ninth below. (*Vide* Fig. 46.)

A vertical (antero-posterior) section should be made into the optic thalamus, to show that no nuclei can be distinguished in it. Its grey and white matter are mingled. A vertical section made through the corpus striatum shows that the grey matter is divided into two parts by the white. The layer of grey matter which protrudes into the ventricle is called the nucleus caudatus, or intraventricular nucleus. The nucleus beneath the white matter is called the nucleus lenticularis, or extra ventricular nucleus. There is another nucleus (claustrum) between the nucleus lenticularis and island of Reil, but it is more difficult to see. Lastly, a vertical section should be made through the lobes of the cerebellum to display the arbor vitæ and nucleus dentatus.

CHAPTER XV.

DISSECTION OF THE LIGAMENTS OF THE SPINE AND SPINAL CORD.

THE student may now return to the vertebral column, *which has been completely stripped of its muscles.* It includes the sacrum below, and at the upper part the occipital bone, or what is left of it. The vertebral extremities of the ribs also remain attached by their ligaments. The dissection should be performed in the following order:

(1) Ligaments which unite the ribs to spine.
(2) Ligaments which unite the vertebræ externally.
(3) Spinal cord and membranes.
(4) Ligaments which unite vertebræ internally.
(5) Ligaments which unite the head to the spine.

Before any dissection is performed, the different curves of the spinal column should be examined, and its range of movement noted. It should be seen where flexion, extension, and rotation are freest. Nearly all of these movements may be ascertained upon the student's own person. Afterwards the occipital bone should be flexed and extended (nodding) on the atlas, and afterwards rotated. Rotation will be seen to occur between the atlas and axis. A spinal column removed from its connections loses many of its peculiarities, and, owing to the time it has been preserved, its range of movement may have become altered. The ribs are attached to the bodies, and to the transverse processes of the vertebræ, by the following ligaments.

To the bodies by

Stellate, or anterior costo-vertebral.
Capsular.
Interarticular.

To transverse processes by

Anterior costo-transverse.
Middle costo-transverse.
Posterior costo-transverse.
Capsular.

For the more minute details concerning these ligaments, a text-book should be consulted. In order to display them the connective tissue should be completely removed, the point of the knife being dipped well in amongst the fibres. If the ligaments are very dry, they should be well soaked in water before dissection. Afterwards, the neighbouring bone should be well scraped with the handle of the knife, so that its periosteum is removed, and the exact attachments of the ligaments defined. One ligament, the middle costo-transverse, lies between the neck of the rib and the transverse process, and is concealed from view. To demonstrate it, the rib and transverse process should be sawn through in such a manner that the cut passes through the long axis of each. This need only be done in the case of one or two ribs. To show the ligament (interarticular) which unites the ridge upon the head of the rib to the intervertebral fibro-cartilage (except the first, tenth, eleventh, and twelfth), the capsular ligament which surrounds the head of the rib and unites it to the vertebræ should be divided all round, and the rib drawn slightly away.

The ligaments which join the vertebræ together may be classified as

(1) Ligaments of bodies:

Anterior common.
Posterior common.
Intervertebral fibro-cartilage.

(2) Ligaments of laminæ :
Ligamenta subflava.

(3) Ligaments of articular processes :
Capsular.

(4) Ligaments of spinous processes :
Interspinous.
Supraspinous.

(5) Ligaments of transverse processes :
Intertransverse.

The anterior common ligament and the external surfaces of the intervertebral fibro-cartilages should be cleaned in a similar way to the rib ligaments. In cleaning these ligaments, numerous veins require to be removed, but in dissecting-room parts the veins are in such a condition that they cannot be cleaned. They should be studied upon a museum specimen. Afterwards, the interspinous and intertransverse, and the external surfaces of the capsular ligaments, may be displayed. In the lumbar regions the ligamenta subflava can be partially seen outside, but to see them in the dorsal region (where they are well marked) it is necessary to remove the whole of one side of the back of the vertebral canal. By cutting through the lamina and the pedicle, and removing the spinal cord and its membranes, they can be examined from the interior. Before endeavouring to see the ligamenta subflava, the posterior occipito-atloid and atlo-axoid ligaments should be cleaned. The structures which pierce them have already been seen. (*Vide* page 289.) The ligaments which unite the vertebral column and pelvis may be seen to be exactly the same as are found in other regions of the spine. The only difference is that the intertransverse ligament descends to the sacrum, and is called the lumbo-sacral, and that a ligament passes from the tip of the transverse process to the crest of

the ileum. This ligament (ilio-lumbar) corresponds to the middle costo-transverse, and was divided when the ileum was removed to make a side view of the pelvis. (*Vide* page 175.) The remaining ligaments will be dissected after the spinal cord.

Dissection of the spinal cord.—With a saw, and bone forceps, the spinal canal should be opened from behind throughout its whole length. Above, the posterior arch of the atlas should be cut through at each side, afterwards the laminæ of all the vertebræ as far outwards as possible. The sacral canal must also be opened. The principal contents of the spinal canal which require dissection are :

The membranes and sub-arachnoid space.	Spinal cord and roots of nerves. Spinal nerves (ganglia).

Afterwards, the posterior common ligaments and the ligaments which connect the spine to the skull. In removing the back of the canal in the dorsal region, an attempt should be made to remove a few of the laminæ intact, in order to be able to examine the ligamenta subflava. To accomplish this, the vertebral extremity of the rib should be removed, and the pedicle of the vertebræ divided with the bone forceps. The laminæ and spines can now be detached, and internal surface of the ligaments cleaned.

When the skull was dissected, its dura mater was seen to form a periosteum for the bones, to send septa into the brain, and form sinuses for the blood. The dura mater, or theca, of the cord does none of these things, but simply forms a sac for the cord. This sac is capacious above, narrow in the dorsal, and very capacious in the lumbar and sacral regions. Above, it is attached to the margins of the foramen magnum ; below, it ends in a pointed extremity, which is fastened to the bottom of the sacral canal. A number of veins (meningo-rachidian) and quantity of

connective tissue, exist between the dura mater (theca) and periosteum of the vertebræ. They should be roughly removed from behind by scraping the dura mater with the handle of the knife. Afterwards, with the scissors the dura mater should be divided throughout its whole length in the middle line, and its edges spread wide open, and fastened to the bones with pins. The parts which require examination are the

Arachnoid and subarachnoid space.
Spinal arteries.
Spinal cord.
Roots of nerves.
Cauda equina.
Filum terminale.
Ligamenta dentata.
Spinal accessory nerve.

The inner surface of the dura mater is smooth, because it is covered with a layer of endothelial cells, which constitute what used to be called the parietal layer of the arachnoid. This must be considered as really part of the dura mater, as it has no connection with the membrane next seen. The arachnoid (formerly spoken of as the visceral layer of the arachnoid) is very delicate, and makes a sac for the spinal cord and for the anterior and posterior nerve roots. This sac is far too large for its contents, and is applied close to the parietal layer. A very considerable space is therefore left between the arachnoid (visceral layer) and the surface of the cord, covered by pia mater. This space is the subarachnoid space, and it is crossed by the nerve roots and ligamenta dentata, both of which pierce the arachnoid. Towards the lumbar region the arachnoid can easily be seized with the forceps, and its thinness and looseness seen. (*Vide* Fig. 47.) The spinal cord, continuous above with the medulla, ends below (in the adult) about the second lumbar vertebra. The roots of the spinal nerves emerge from the sides of the cord, run across the subarachnoid space, and pierce the dura mater

opposite their exit from the vertebral canal, *i.e.*, opposite the intervertebral foramen. There is a

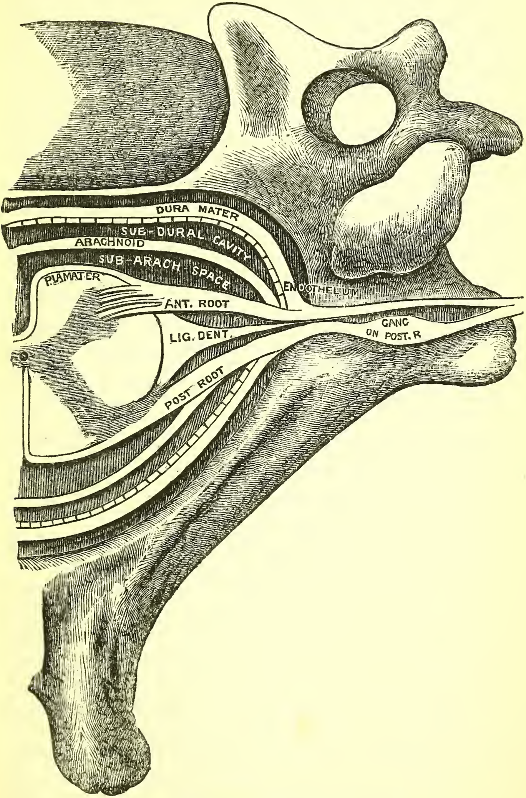


Fig. 47.—Membranes of Spinal Cord.

ganglion upon the nerve roots which emerge posteriorally (posterior roots), and this ganglion is always situated outside the dura mater. Usually the ganglion is in the intervertebral foramen, but in the case of the great occipital nerve (second) it is between the posterior arch of the atlas and lamina of the axis, and in the case of the sacral nerves, within the sacral canal. The upper nerve roots run almost horizontally from the cord to the ganglion on the posterior root. Owing to the fact that the cord ends at the second lumbar vertebra, and that the sacral ganglia are far off, near the sacral foramena, it follows that the roots which go to these ganglia are of immense length. The extreme length of the lumbar and sacral nerve roots is accounted for by the fact that at an early period of fœtal life the cord was the same length as its canal. Afterwards, the bones forming the canal grew more quickly than the cord. The nerves and ganglia being fastened to the bones, were dragged away from the cord, and the nerve roots between the cord and ganglia elongated. The filum terminale has a similar origin, but is the remains of the spinal cord itself. The anterior and posterior roots of the nerves form the brush of nerve fibres (cauda equina), which fill the lower part of the subarachnoid space. The spinal cord should be examined, in order to see two small arteries, which, if well injected, can be seen to run down at each side of the posterior median fissure. They come from the vertebral, and receive reinforcement all the way down the cord from small arteries which run in towards the cord along the nerve roots. These reinforcements come from all the arteries which are in proximity to the cord. A single artery may afterwards be seen running in a similar manner, and similarly reinforced, along the anterior median fissure of the cord. The thickenings of the cord in the cervical and lumbar regions may be noted, and the

lower end of the cord followed down until it becomes exceedingly thin and tapering, and continuous with a very delicate white fibre, called the filum terminale. The filum terminale lies amongst the fibres of the cauda equina, from which it may be distinguished by its whiter colour. It may be traced as far as the middle of the sacrum, but is easily broken. In the dorsal and cervical regions, if the nerve roots be separated and the cord itself drawn towards the opposite side, some (twenty-five) triangular processes of pia mater (ligamenta dentata) can be seen (Fig. 47). They are attached by their base to the cord, and after passing across the subarachnoid space, their apices pierce the arachnoid, to be attached to the dura mater. Besides the ligamenta dentata, the spinal portion of the spinal accessory nerve runs upwards between the anterior and posterior roots of the upper five or six cervical nerves.

The dissection should now be continued, in order to see the ganglia upon the posterior roots of the spinal nerves. It is quite sufficient to dissect one or two. The bone (articular process) should be cut away, until the intervertebral foramen is exposed from behind. The nerve roots may then be traced from the cord, the dura mater being divided to expose their exit. The ganglia are situated in the posterior root, and the anterior root may be seen joining the nerve trunk beyond it. If well injected, the small arteries previously mentioned may be seen entering the canal with the nerve trunks. They are especially well marked in the lumbar and dorsal regions.

The roots of the spinal nerves may be divided within the canal, in order to remove the cord, and see its anterior surface and the anterior spinal artery running down it. Sections may afterwards be made transversely through the cord, in order to see the grey matter in the interior. Unless the cord be fresh,

this cannot be seen; the same remark applies to the pia mater. The dura mater should afterwards be taken away. To do this, the nerve roots should be cut through outside it. The posterior common ligament may now be cleaned from beginning to end.

The ligaments which unite the head to the spine are next to be examined. They may be conveniently classified into:

(1) Those connecting occipital bone and atlas:

Anterior occipito-atloid.	Capsular.
Posterior occipito-atloid.	Lateral occipito-atloid.

(2) Ligaments connecting occipital bone and axis:

Occipito-axoid.	Three odontoids.

(3) The ligaments connecting the atlas and axis.

The anterior occipito-atloid and atlo-axoid require no special rules for their dissection. Any remains of the small muscles in this region should be removed. The anterior occipito-atloid ligaments, although divided into superficial, deep, and lateral, are really only one ligament. Within the canal, the upper part of the posterior common ligament, where it stretches from the back of the body of the axis to the occipital bone, is called the occipito-axoid, or apparatus ligamentosus colli. It should be divided just below the prominence of the tip of the odontoid process, and its ends turned upwards and downwards. The transverse or cruciate ligament, which keeps the odontoid process in place, may then be cleaned, and afterwards the odontoid, or check ligaments, traced from the odontoid process to the occipital bone. A couple of vertebræ may be taken from the middle of the column, and divided vertically with a saw. The structure of the intervertebral disc and of the bodies of the vertebræ may then be examined. Upon the bone the venæ basis vertebrarum and vertical cancelli are easily seen.

CHAPTER XVI.

DISSECTING QUESTIONS.

It is the custom, especially in the higher anatomical examinations, to ask what are called dissecting questions, *i.e.*, what is the dissection necessary to expose some definite structure, such as, for example, the supinator brevis, etc.

It is commonly imagined by the student that these questions are of such a nature that they can only be answered by one who has an enormous experience of anatomy, and involve considerably more knowledge than that which is ordinarily acquired in a dissecting-room. Nothing could be more erroneous. They are only the necessary outcome of a knowledge of relations which have been so often referred to in the preceding pages.

The student who has succeeded in imprinting on his mind the exact relative position of the structures which he has dissected, will have no difficulty in answering a dissecting question; whilst he who has studied the mere distribution of an artery or nerve, without accurately learning its relations to the surface or its surroundings, will be quite at sea with such a question. For this reason they are excellent tests of whether anatomy has been studied practically, and show at once whether the student can mentally visualise the composition of the body to himself, as if it were a transparent picture.

When once the student has dissected his part, or, better still, the whole body, he must study it from a new standpoint. By dissection he has studied it by the process of analysis (the separation of its component

parts); he must now apply to it the process of synthesis (their building up).

Let him stand in front of an articulated skeleton, and taking a series of pieces of paper, apply or mould them one by one to the dry bones; he will build up the body as he goes along, first the muscles, and then the minuter structures. Each will fall into its place with accuracy, when once the larger parts are put in as landmarks. The more nearly the student can carry out this ideal, the more nearly he approaches to the perfect anatomist.

If he will set about his anatomy in this way in a large dissecting-room, where ample means are at hand to correct his mistakes, he will advance with rapid strides, and his anatomy, instead of a mass of dry facts, will stand out before him as a beautiful and well-proportioned picture.

He will then find that to answer the more ordinary of these questions is a comparatively simple task, and depends upon his acquaintance with what is called regional anatomy, that is to say, a knowledge of exactly what region an organ or structure occupies.

To be called upon to display a very deeply-seated structure, which is surrounded by many important and complicated parts, is much harder, but not so hard a task as it at first sight appears.

A few simple principles can be laid down concerning these dissection questions. In the first place, the student must picture to himself the exact situation, size, and shape of the structure which he wants to expose. The next thing to be done is to make a surface marking for the structure in question; for the test of a good dissection answer is to lay the structure bare, with as little disturbance of the surrounding parts as possible. For this purpose definite bony prominences should, whenever it is possible, be chosen as landmarks for the incisions.

The structures should be removed as much as possible layer by layer. If muscles require to be reflected, they should, if it is possible, be removed by cutting through their attachments, as in this way an opportunity is afforded to display a knowledge of them. It should be also mentioned whether the nerve or arterial supply of the muscle requires to be divided during its removal.

One example carefully worked out will illustrate these principles.

Suppose the question is how to expose the popliteus muscle. This muscle is in contact with the tibia and femur almost over the whole of its anterior surface. Any student with a fair knowledge of bones, who had dissected a leg, could, if given a piece of paper cut to the shape of a popliteus, put it in its proper position, and a knowledge of the bony prominences about the knee-joint would enable him to draw its surface markings on the back of the knee. We may take it for granted that no one in his senses would attempt to expose it from the front, unless specially asked to do so.

The structures to be removed are simply those which would be cut away in dissecting the lower part of the popliteal space and origin of gastrocnemius, with the addition of the division of the lateral and capsular ligaments of the joint, and the biceps tendon.

The details of the answer would be more as follows :

Make an incision from the external tuberosity of the femur, sloping slightly downwards and inwards, as far as the upper edge of the inner tuberosity of the tibia.

From the extremities of this incision make a vertical one along the inner edge of the tibia, which can easily be felt, as far as the junction of the upper and middle thirds. The remaining incision should begin at the lower end of the last, and pass

upwards and outwards to the styloid process of the fibula, and onwards to the commencement of the first incision at the outer tuberosity of the femur.

Remove the skin thus marked out.

There will be exposed in the subcutaneous tissue the small sciatic nerve, posterior saphenous vein, and perhaps also some small branches from the external and internal popliteal nerves, and likewise from the internal cutaneous and saphenous nerves; cutaneous veins from internal saphenous and the main trunk, and cutaneous arteries from the popliteal or articular branches; some lymphatics, and a lymphatic gland.

The superficial fascia, with all these structures, must be removed. The relative positions of these structures should be mentioned in the answer.

The deep fascia would then be exposed, and must be removed over the exact area of the incision.

The gastrocnemius and plantaris, with the hamstrings, would then be exposed and cleaned; the nerves and arteries to the gastrocnemius and plantaris are seen, as also are the popliteal artery, vein, and internal popliteal nerve in the popliteal space; the corresponding veins will be also visible.

The communicantes peronei and poplitei would be seen.

If the gastrocnemius and plantaris, with their arterial and nerve supply, be now removed at the edges of the pit which the student is making, the popliteus will be exposed, with more of the popliteal artery, vein, and external and internal popliteal nerves crossing over it. The biceps tendon, and the long and short external lateral ligaments, and capsular ligament, should then be divided at the outer side

* Students often ask whether they are supposed to remove the structures, which must be cut through in answering a dissection question, or reflect them. It is quite immaterial which they do, but it is perhaps easier to adopt the former plan.

of the knee-joint, and the popliteus muscle and its tendon, which is within the joint, will be exposed.

To show it perfectly the expansion of the semi-membranosus which covers the muscles must be cut away, and the popliteal vessels and nerves cut across. Probably in actual dissection this would not be done, unless the student was specially asked to clear everything from the surface of the muscle.

There would be exposed, in addition, the nerve to the popliteus, coming off from the popliteal high up and running over the surface of the muscle to curl round its lower border, which abuts on the soleus. Some articular arteries, veins, and nerves from the popliteal vessels and nerves will be seen running along its borders.

A few more particulars about the relative position of the parts as they were exposed in order, and everything would have been described that possibly could have been expected from the most advanced of students. Supposing even that a few of the smaller structures had been omitted, the answer would still have been well planned, and have shown a thorough rational knowledge of anatomy, and would therefore ensure favourable attention.

Supposing, however, that the popliteal artery had been described as running outside the gastrocnemius, or the popliteus muscle had not been described as in relationship with the biceps tendon; or, supposing it was evident from his answer that the student did not know that the tendon of the muscle perforated the capsular ligament, then the answer would count but little, even though many unimportant minutiæ had been churned up with it.

Repeated handling of parts in the dissecting-room is a sure safeguard against all such errors, and is the shortest and easiest way to learn anatomy, if only the student would believe it.

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